

Kingdom of Saudi Arabia  
Ministry of Communications

# Manual on Uniform Traffic Control Devices

This manual is one of a series of manuals covering highway design and construction, construction materials, highway and bridge maintenance, surveying and mapping, and uniform traffic control devices, prepared in cooperative effort by the Ministry of Communications of the Kingdom of Saudi Arabia and the Federal Highway Administration of the United States of America.

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# Part 1. General Provisions

## Purpose of Traffic Control Devices

Traffic control devices improve highway safety by providing for the orderly movement of vehicles, pedestrians, and other conveyances throughout the Kingdom's highway transportation system. These devices also provide drivers with guidance and warnings for safe and informed operation.

## Requirements of Traffic Control Devices

A. This Manual sets forth the basic principles that govern the design and usage of traffic control devices.

B. The Manual presents standards for traffic control devices to be used on all highways under the jurisdiction of the Ministry of Communications. Other agencies are encouraged to consult this Manual to insure the consistent use of these devices throughout the Kingdom.

C. To be effective, traffic control devices must meet five basic requirements:

1. Fulfill a need.
2. Command attention.
3. Convey a clear, simple meaning.
4. Command respect of road users.
5. Give adequate time for proper response.

D. Five basic considerations are used to insure these requirements are met: Design, Placement, Operations, Maintenance, and Uniformity.

E. In the case of regulatory devices, the actions required of vehicle operators and pedestrians are specified by the **Traffic Regulations**, adopted by Royal Decree and in force throughout the Kingdom.

Design, placement (location), operation (application), maintenance, and uniformity (consistency) determine the effectiveness of traffic control devices.

## Responsibility for Traffic Control Devices

The responsibility for traffic control devices rests with the Ministry of Communications, the Provinces, through their respective Governors, and the cities, through their respective Mayors, for roads under their jurisdictions.

## Engineering Study

The provisions of this Manual are the standards for the installation of traffic control devices. Engineering judgement must be used in determining needs, and if a qualified engineer is not available, assistance from the Ministry of Communications should be sought.

## Development of New Standards

As this Manual is implemented, the need to develop refinements to the Manual will become apparent. The Ministry of Communications (Traffic Engineering Department) will be the coordinating office to assemble a file of these desired or necessary changes.

## Relation to Other Documents

Several documents have a direct bearing on this Manual: **Traffic Regulations**, adopted by Royal Decree, and the Manuals for **Design, Construction, Materials, and Maintenance**.

## Color Code

The following color code establishes general meanings for seven colors appropriate for use in conveying traffic control information. Central values and tolerance limits for each color are available through the Ministry of Communications, Traffic Engineering Department.

1. **YELLOW**—Work area signs, warning signs, pavement markings, zigzag no-parking zones, traffic signal change warning indication, channelizing islands.
2. **WHITE**—Regulatory signs, certain Informative signs, edge lines, lane lines, crosswalks, stop lines, word and symbol pavement markings, pedestrian signal indications, cross-hatching markings (chevrons).
3. **RED**—STOP and traffic signal stop indication, prohibitive indication, and messages on certain Regulatory, Warning and Informative signs.
4. **BROWN**—Recreational and cultural interest areas.
5. **BLACK**—Certain Informative signs, symbols on signs, end prohibition.
6. **GREEN**—Portion of symbol on Signal Ahead sign, traffic signal proceed indication, route markers, and certain Informative signs.
7. **BLUE**—Certain Regulatory and Informative signs.

## Authority for Placement

Traffic control devices shall be placed only by the authority of a public body or official having jurisdiction for the purpose of regulating, warning, or guiding traffic.

## General Prohibitions—Advertising and Confusing Devices

Any unauthorized devices placed on the highway right-of-way by a private organization or individual constitutes a public nuisance. All unofficial or nonessential devices shall be removed.



## Part 2. Signs

### 2.01 Introduction and General Standards

#### A. Function of Signs

Signs are to be used only where this Manual indicates the need for placement. Signs are required where special regulations apply at specific places or at specific times only, or where hazards are not self-evident. Signs also give information as to highway routes, directions, destinations, and points of interest. Rules of the road can stand alone, and signs are not needed to confirm the rules.

#### B. Scope of Sign Standards

1. This Manual prescribes standards for the signing within the right-of-way of all design classifications of public highways (see Highway Design Manual). Detailed standards for Warning, Regulatory, and Informative signs are found in successive sections. The general signing requirements for expressways and arterials have the same standards for use and design, especially for Informative signs.

2. Roadway geometric design and signing shall be coordinated providing effectively placed signing to give drivers necessary informative, regulatory, and warning information.

#### C. Standardization of Application

1. Each standard sign shall be displayed only for the specific purpose prescribed for it in this Manual.

2. Uniformity of design and placement is as important as the use of standard signs. Identical conditions shall always be indicated with the same type and placement of sign, despite where those particular conditions occur.

3. Urban and rural traffic conditions differ, and, in many instances, signs must be applied and located differently. Where pertinent, this Manual sets forth separate recommendations for rural and urban conditions.

#### D. Variable Message Signs

1. Variable message signs are designed to have one or more messages, which may be displayed or deleted as required. Such a sign may be changed manually, by remote control, or by automatic controls which “sense” the conditions requiring special sign messages.

2. Some variable message signs cannot conform to the exact shape, color, and dimensions specified in these standards because of technological limitations. A desirable usage

of the variable message sign is with advance warnings to reduce collisions of high vehicles with highway structures, where “sensor” devices can be used.

#### E. Excessive Use of Signs

A conservative use of Warning and Regulatory signs is recommended. If used to excess, these signs tend to lose credibility and then effectiveness. In the case of Informative signs, frequent display to keep drivers informed does not lessen the value.

#### F. Classification of Signs

Functionally, signs are classified as follows:

1. Warning signs call attention to conditions on, or adjacent to, a highway or street potentially hazardous to traffic operations.
2. Regulatory signs give notice of traffic laws or regulations.
3. Informative signs show route designations, destinations, directions, distances, services, points of interest, and other geographical, recreational, or cultural information.

#### G. Design

Uniformity in design includes shape, color, dimensions, legends, and illumination or reflectorization. This Manual shows many typical standard signs. The standards for these designs do not preclude making minor changes in proportion of symbols, width of borders, or layout of word messages, but all shapes and colors shall be as indicated.

#### H. Shapes

Standard sign shapes are as follows:

1. The octagon shape shall be reserved exclusively for the STOP sign.
2. The equilateral triangle, with one point downward, shall be reserved exclusively for the Give Way sign. The equilateral triangle, with one point upward, shall be reserved exclusively for Warning signs.
3. The round shape shall be reserved exclusively for Regulatory signs.
4. The rectangle shall be used for Informative signs, basically for advance direction, direction, and confirmatory. The square or rectangle, the latter with the longer dimension either vertical or horizontal, shall be used for the Pedestrian Pushbutton sign, Useful Information signs, Facilities signs, and Parking signs.

## **I. Colors**

The colors used on standard signs shall be as follows (The Ministry of Communications has color chips and specifications for all colors described in this manual):

1. Red is used as a background color for the STOP sign. Red is used for messages or borders on certain Warning signs, certain Regulatory signs, and certain Informative signs.
2. White is used as a background color on Regulatory, Warning signs, and certain Informative signs. White is used as the message or border on blue, red, black, and brown signs.
3. Blue is used as a background color for all Mandatory signs and certain Informative signs.
4. Yellow is used on some information panels and as a background for the signs in work areas.
5. Black is used as a background color for certain Informative signs. Black is used for messages on yellow and white signs. Black is used for messages on End of All Special Prohibitions Imposed on Moving Vehicle signs.
6. Brown is used as a background color for Recreation and Cultural Interest signs.
7. Green is used on certain informative signs.

## **J. Dimensions**

The sign dimensions prescribed in this Manual shall be the standard for application on highways within the Kingdom under the jurisdiction of the Ministry of Communications. Where greater legibility or emphasis is needed, the standard sizes should be increased. Larger signs are prescribed for expressways.

## **K. Lettering**

The Arabic letter style shall be Naskh. Proper names in Arabic shall be translated in English; Arabic street names shall be a transliteration in English. Only Arabic numbers in Naskh style shall appear on all route markers and speed limit signs.

## **L. Illumination and Reflectorization**

Warning and Regulatory signs shall be reflectorized or internally illuminated to show the same color day and night. All Informative signs shall be reflectorized and, in certain instances, shall be illuminated as well. Reflectorization shall be obtained by reflectorizing the background or by using button or sheeting copy on an opaque background, or a combination of

both. All overhead signs shall be illuminated where possible.

## **M. Sign Borders**

With the exception of warning signs or as noted below, all signs shall have a border the same color as the legend. The border widths should generally not exceed the stroke-width of the Arabic lettering of the sign, however, a minimum border width of 30 mm should be used. For signs exceeding 2 m by 3 m in size, the border should be approximately 50 mm wide or on unusually large signs, 75 mm may be appropriate. The corners of the sign border shall be rounded. Where practicable, the corners of the sign panels should also be rounded to fit the border.

1. Borders on Warning signs shall be red and shall have the dimensions to approximate the widths illustrated for each sign.
2. Borders on Regulatory signs shall be red except for the STOP sign, which shall be white and the No Entry sign, which has no border.
3. Mandatory signs do not have a border.
4. Useful Information signs do not have a border.
5. White on blue or green advance direction signs and direction signs shall have a white border. A black border shall be used on advance direction and direction signs with a white background.

## **N. Standardization of Location**

1. Standardization of location for locating signs cannot always be attained in practice. However, the general rule is to locate signs on the right hand side of the road where the driver is looking for the signs. On wider facilities, or where some degree of lane-use control is desirable, or where space is not available at the roadside, overhead signs are often necessary. Supplementary signs may be helpful at times if the initial signs are not in a direct line of sight for the driver. A supplementary Warning sign shall be located on the left median of a divided highway or on the left of a one-way roadway where the view of the standard sign in the normal location may be obstructed by traffic.
2. Signs should not obscure each other or be hidden from view by other objects.
3. Signs should not block the view of a driver approaching an intersection to traffic approaching from an intersecting street.
4. Spacing between signs must be sufficient to allow time for the driver to make the required decisions safely.

5. Standard positions for typical signs are illustrated in Figures 2-1 to 2-4b.

#### **O. Overhead Sign Installations**

1. Overhead signs have value at many locations. The following conditions provide a basis for justifying the erection of overhead sign displays:

- a. Traffic volume at or near capacity for highways with two or more lanes.
- b. Complex interchange design.
- c. Three or more lanes in each direction.
- d. Restricted sight distance.
- e. Multi-lane exits.
- f. Large percentage of trucks.
- g. Street lighting background.
- h. High speed traffic.
- i. Consistency of sign message location through a series of interchanges.
- j. Insufficient space for ground mounted signs.
- k. Junction of one major road with another.

2. One or more of the conditions listed above do not in themselves automatically justify the use of overhead signs. Close coordination between design and operation at the design stage make some of these elements less critical.

#### **P. Height**

1. Signs erected at the side of the road in rural areas shall be mounted at a height of at least 1.5 m measured from the bottom of the sign to the nearest edge of the pavement. In business, commercial, and residential areas where parking and/or pedestrian movement is likely to occur or the driver's view is obstructed, the clearance between the bottom of the sign and the pavement shall be at least 2 m.

2. On major roads, the advance direction, direction, and confirmation signs shall be erected with the clearance between the bottom of the sign and the pavement being 2 m.

3. Overhead signs shall provide a clearance of not less than 5.5 m.

#### **Q. Lateral Clearance**

1. Signs should have the maximum practical lateral clearance from the edge of the traveled way, to increase safety of motorists who may accidentally run off the road striking sign supports. Breakaway or yielding supports shall be used.

2. Normally, signs should not be closer than 2 m from the edge of the shoulder or, if no shoulder exists, 3.5 m from the edge of the traveled way. Large Informative signs should be placed preferably 9 m or more from the nearest traffic lane. In urban areas, 0.5 m is recommended as a clearance from the curb face. Overhead sign supports shall not be erected in gore areas or other exposed locations. Where desirable or necessary, impact attenuators should be placed around the base of the overhead sign structure. In many instances, the location of Informative and Warning signs can be shifted to take advantage of existing roadway devices such as guardrail or overcrossing structures to minimize the exposure of sign supports to traffic.

#### **R. Position**

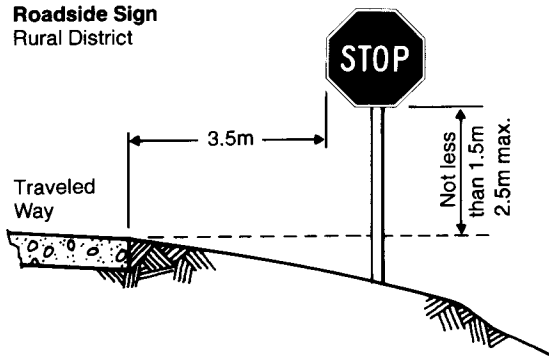
1. A Warning sign is placed in advance of the condition to which it calls attention.

2. A Regulatory sign normally is placed where its mandate or prohibition applies or begins.

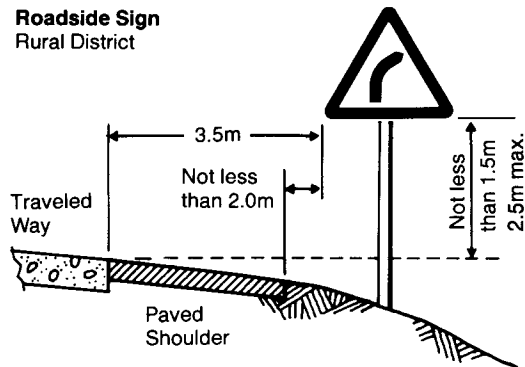
3. Informative signs are placed, where needed, to keep drivers well informed as to their route and destination.

4. Detailed standards for sign locations are given in sections of the Manual dealing with individual signs or classes of signs.

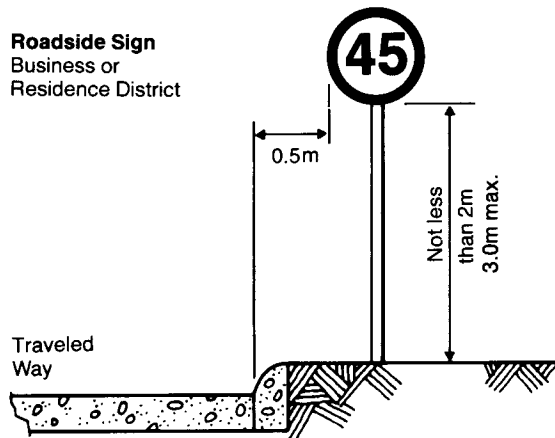
**Roadside Sign**  
Rural District



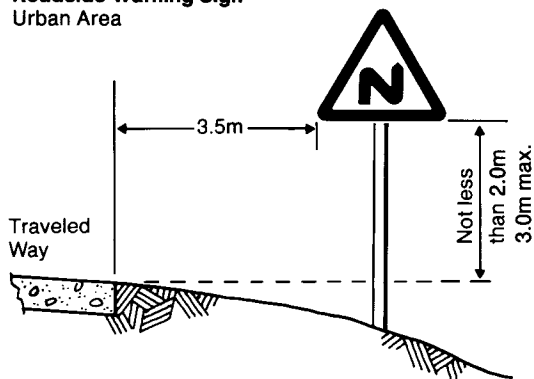
**Roadside Sign**  
Rural District



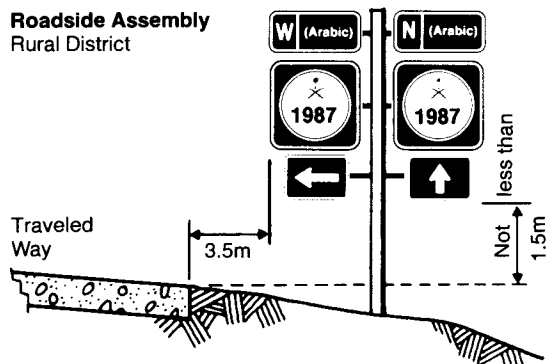
**Roadside Sign**  
Business or  
Residence District



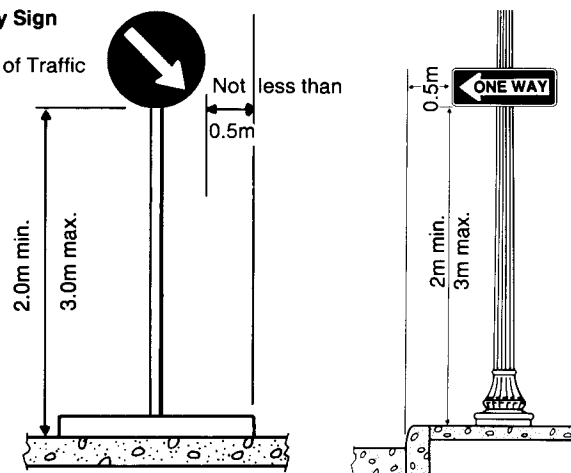
**Roadside Warning Sign**  
Urban Area



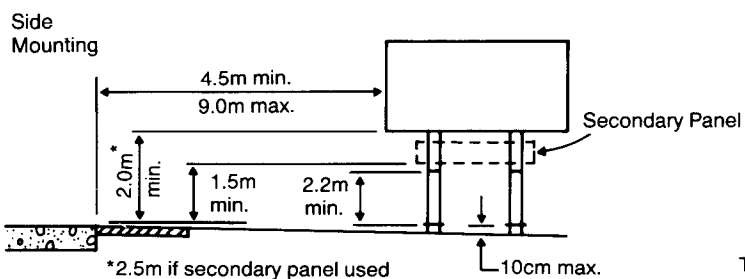
**Roadside Assembly**  
Rural District



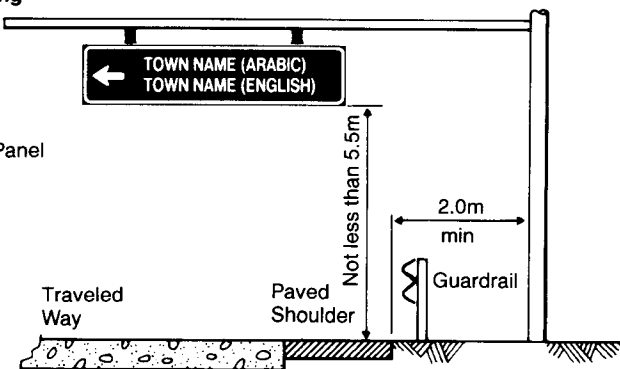
**Mandatory Sign**  
On Island  
In the Line of Traffic



**Side Mounting**

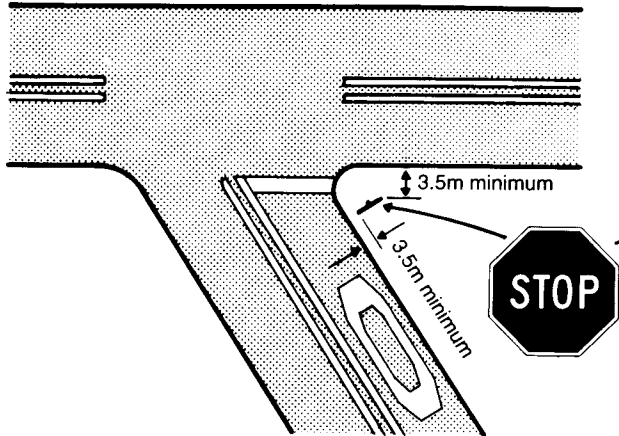


**Overhead Mounting**

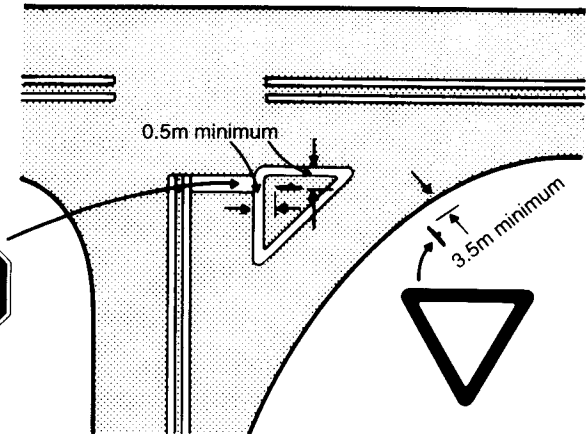


**Figure 2-1**  
Height and lateral location of signs—typical installations.

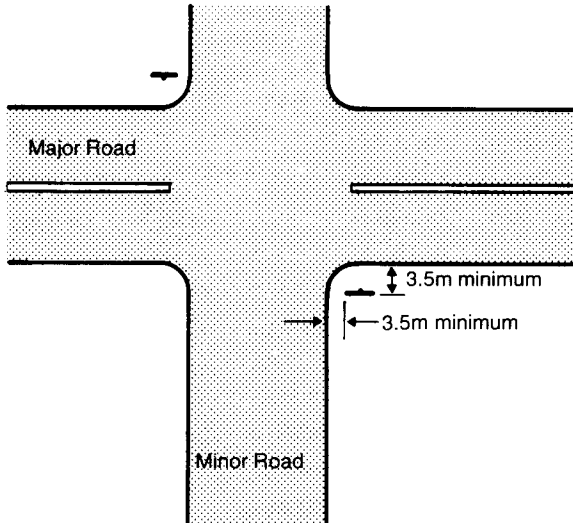
**Acute Angle Intersection**



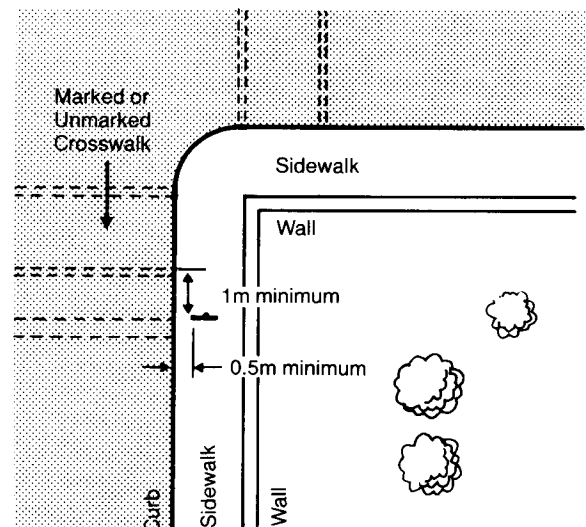
**Channelized Intersection**



**Minor Crossroad**

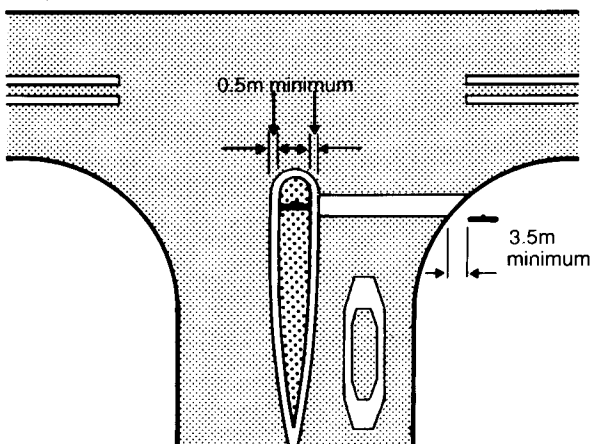


**Urban Intersection**

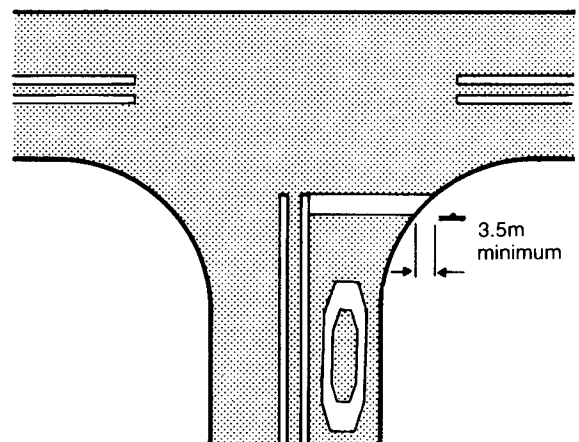


**Note:** All pavement markings shall conform to Part 3- Markings

**Divisional Island**



**Wide Throat Intersection**



**Figure 2-2**  
**Typical locations for STOP signs and GIVE WAY signs.**

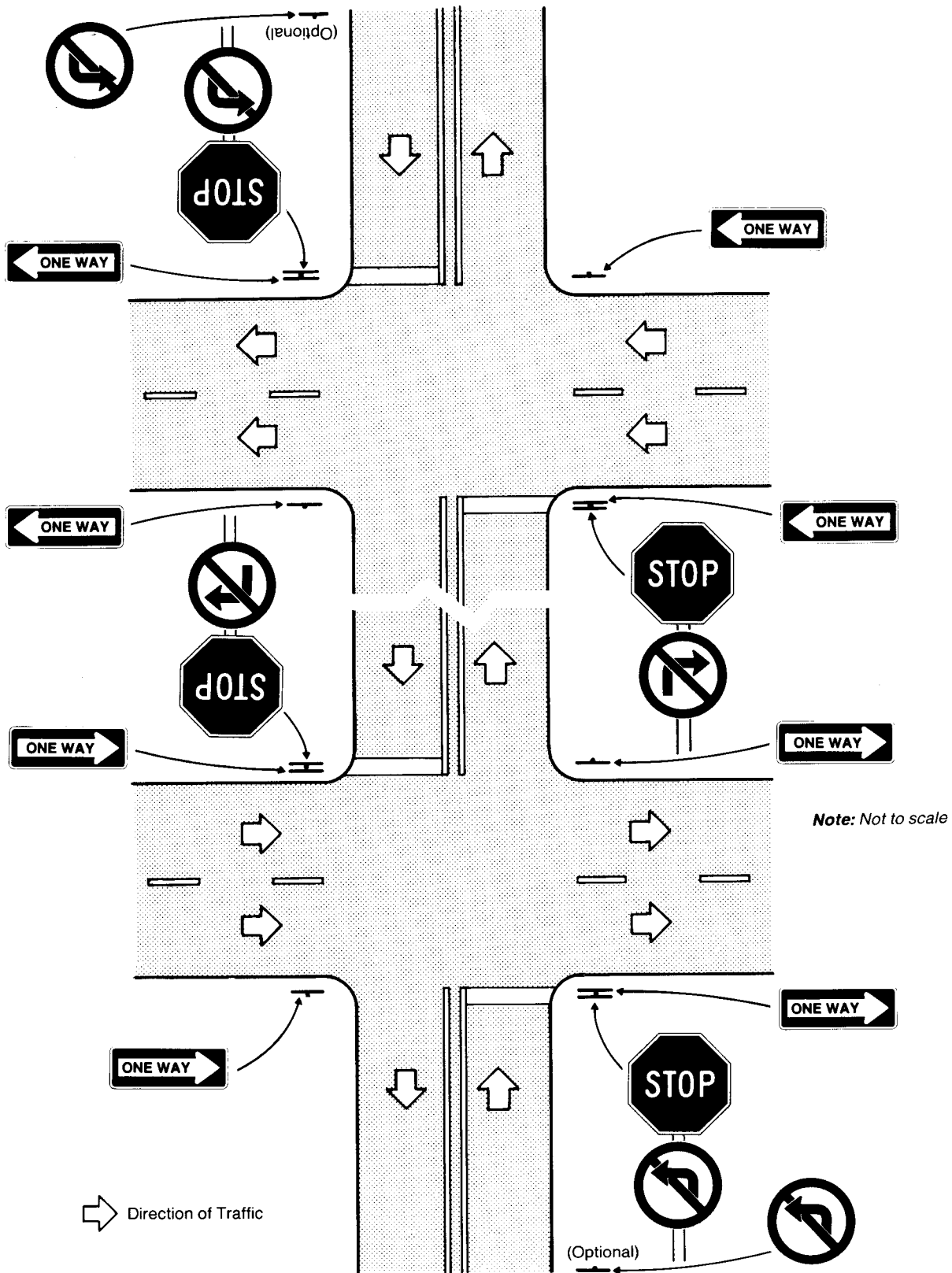
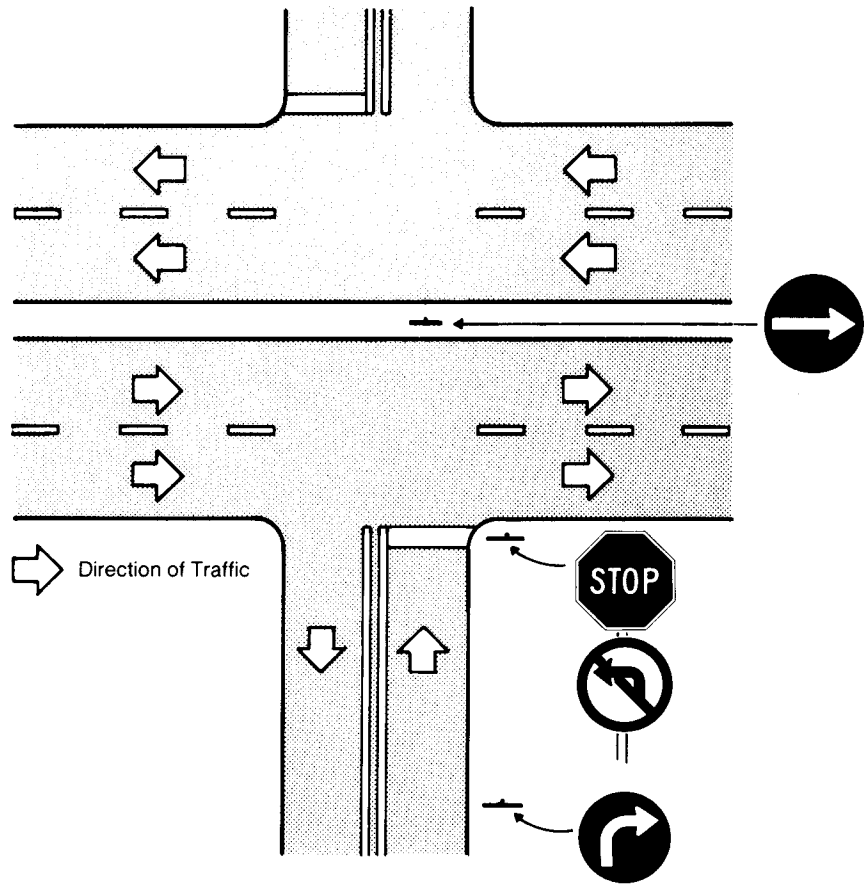
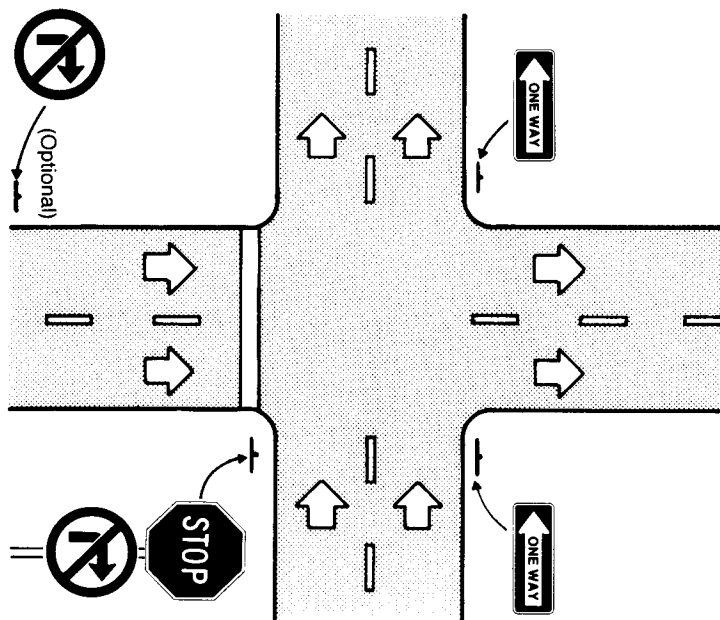


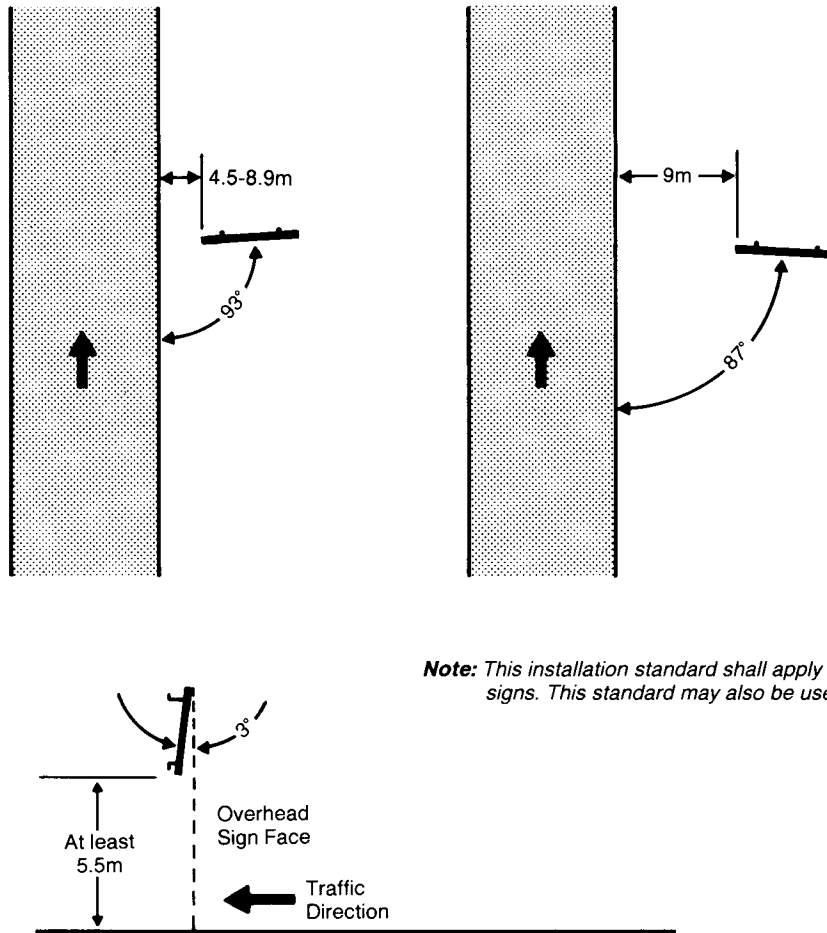
Figure 2-3  
Location for One-way and turn prohibition signs.



Mandatory movement signs



**Figure 2-4**  
Typical location for One-way signs.



**Note:** This installation standard shall apply to all Expressway signs. This standard may also be used for other signs.

**Figure 2-4a**  
**Typical sign orientation**

### S. Erection

Normally signs are mounted at approximately right angles to the direction of, and facing, the traffic the signs are intended to serve. Where mirror reflection (specular glare) is encountered, the sign should be turned slightly away from the road. Large Informative signs, which are offset 9 m from a defined pavement edge, should generally be slightly turned toward the road. On grades, a sign can be tilted forward or back from the vertical to improve the viewing angle. Overhead signs should be tilted slightly forward.\* (See Figure 2-4a)

### T. Posts and Mountings

1. Sign posts shall hold signs in a proper and permanent position.
2. Sign supports shall be of a suitable break-away or yielding design.
3. Overhead sign supports are nonbreak-away type and shall be protected by the appropriate barriers.

4. In urban areas, signs may be placed on supports such as traffic signals, street lights, and utility poles.

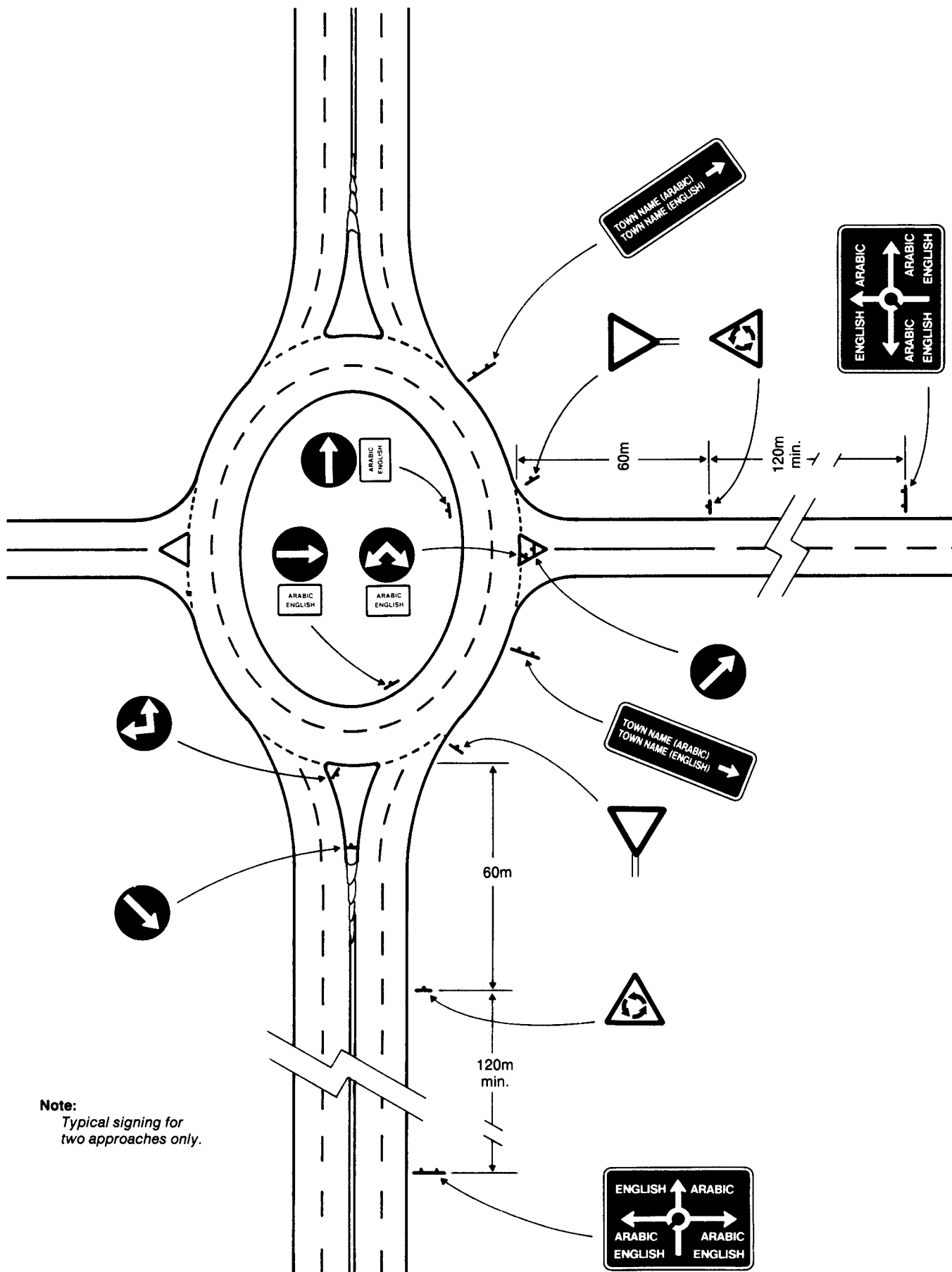
### U. Bridges for Sign Supports

Overcrossing structures frequently can serve for the support of overhead signs. Use of such structures eliminates the need for foundations, sign supports, and protecting barriers along the roadside.

### V. Maintenance

1. All traffic signs shall be kept in proper position, clean, and legible at all times. Damaged signs shall be replaced without undue delay.
2. Weeds, trees, shrubbery, and parked construction and maintenance equipment and materials should not obstruct sign faces.

\*For small ground-mounted signs the forward tilt is not necessary.



**Figure 2-4b**  
**Typical Signing for Roundabouts**

1

2

3

4

## 2.02 Warning Signs

### A. Application of General Warning Signs

1. Warning signs are used when traffic needs to be warned of existing or potentially hazardous conditions on or adjacent to a highway or street. Warning signs require drivers to be cautious and may call for a reduction in speed or a maneuver in the interest of his own safety, or that of other drivers and pedestrians.
2. Use of Warning signs should be kept to a minimum. Unnecessary use of signs to warn of apparent conditions lessens a driver's compliance to warnings truly reflecting dangerous hazards.
3. Typical locations and hazards that may warrant the use of Warning signs are as follows:
  - a. Changes in horizontal alignment.
  - b. Intersections.
  - c. Advance warning of control devices.
  - d. Converging traffic lanes.
  - e. Narrow roadways and roadways with narrow shoulders.
  - f. Changes in the design features of the roadway.
  - g. Steep grades.
  - h. Roadway surface conditions.
  - i. Railroad crossings.
  - j. Entrances and crossings.
  - k. Miscellaneous roadway elements.
4. If warnings other than those listed above or illustrated in this Manual are needed, the signs shall be the standard shape, color, and placement of Warning signs.
5. Warning signs may be accompanied by an educational plaque (in Arabic) placed below the symbol sign.
6. Supplemental plaques may be added to a warning sign to show distances, grades, advisory speeds, or other information.

### B. Design of Warning Signs

1. Generally, all Warning signs shall be a triangle shape. The background color is white, with black symbols on the sign face and a red border, except as specified.
2. All Warning signs shall be fully reflectorized or internally illuminated.

3. The minimum (normal) size for each Warning sign described in this section is 900 mm. Where conditions of speed, volume, or special hazard require greater visibility or emphasis, larger signs are to be used.

### C. Placement of Warning Signs

1. Warning signs shall be erected in accordance with the general requirements for sign positions described in Sections 2.01 N to T.
2. Since Warning signs are primarily for the benefit of the driver who is unacquainted with the road, special care should be given to the placement of these signs. Warning signs should provide adequate time for the driver to perceive, identify, decide, and perform any necessary maneuver. This total time to perceive and complete a reaction to a sign is the sum of the times necessary for PIEV which stands for Perception, Identification (understanding), Emotion (decision making), and Volition (execution of decision). The PIEV time can vary from about 3 seconds for general warning signs to 10 seconds for high driver judgment condition warning signs.

Table 2-1 lists suggested minimum sign placement distances, which may be used for three conditions:

- a. Condition A—a higher driver judgment condition, which requires the driver to use extra time making and executing a decision because of a complex driving situation (lane changing, passing, or merging).
- b. Condition B—a condition where the driver will likely be required to stop.
- c. Condition C—a condition where the driver will likely be required to decelerate to a specific speed.

The placement of temporary warning signs used at highway construction and maintenance sites is covered in Part 5 of this Manual, and the suggested minimum sign placement distances given in Table 2-1 may not apply to that group of signs.

3. Other miscellaneous Warning signs that advise of potential hazards, but are not related to a specific spot, may be installed in the most appropriate locations since these signs are not covered in Table 2-1. These include types such as camel crossing and soft shoulder. Minimum spacing between Warning signs with different messages normally should be based on the PIEV times for driver comprehension and reaction.

Table 2-1<sup>1</sup>**A Guide for Advance Warning Sign Placement Distance**

Posted or 85 – Percentile Speed km/h	Condition A High Judgment Needed <sup>2</sup> (10 Secs. PIEV)	General Warning Signs <sup>3</sup>					
		Condition B Stop Condition	Condition C Deceleration Condition to Listed Suggested Safe Speed – km/h (or Desired Speed at Condition)				
			0	20	40	60	80
30 km/h	50 m	4	4				
40	75	4	35 m				
50	100	35 m	50				
60	130	60	70	60			
70	160	85	95	80			
80	190	110	125	110	80		
90	215	140	155	140	110		
100	245	180	185	175	145	100	
110	275	220	225	210	175	130	
120	305	260	265	250	215	170	120

<sup>1</sup>Distances shown are for level roadways. Corrections should be made for grades as prevailing speeds will alter both upgrade and downgrade due to acceleration or deceleration demands to fit traffic conditions. If 1,200 mm signs are used, the legibility distance may be increased to 60 m. This would allow reducing the above distances by 25 m.

<sup>2</sup>In urban areas, a supplementary plate underneath the Warning sign should be used specifying the distance to the condition if there is an in-between intersection which might confuse the motorist.

<sup>3</sup>Distance provides for 3-second PIEV, 40 m Sign Legibility Distance, Braking Distance for Condition B and Comfortable Braking Distance for Condition C<sup>3</sup>.

<sup>4</sup>No suggested minimum distances provided. At these speeds, sign location depends on physical conditions at site.

<sup>5</sup>In some instances, the suggested distances may have to be altered or a series of signs may be erected to provide a second reminder of the hazard.

Typical Signs for the Listed Conditions in Table 2-1

Condition A–Merge, Right Lane Ends, etc.

Condition B–Crossroad, Stop Ahead, Signal Ahead, Ped Xing, etc.

Condition C–Bend, Divided Road, Hill, Dip, etc.

4. The effectiveness of the placement of any Warning sign should be tested periodically under both day and night conditions.

5. In some instances, the suggested distances

might have to be altered or a series of signs erected in order to provide a second reminder of the hazard.

**D. Sign Designations, Usage and Dimensions****1. Dangerous Bend Sign (W 1)**

a. The Bend sign (W 1-1) is intended for use where engineering investigations of roadway, geometric, and operating conditions show the recommended speed on a bend to be in the range between 50 and 100 km/h and equal to or less than the established speed limit.

b. The Sharp Bend sign (W 1-2) is intended for use where engineering investigations of roadway, geometrics, and operating conditions show the recommended speed on a sharp bend to be 50 km/h or less and this speed is equal to or less than the established speed limit.

c. The Dangerous Bends sign (W 1-3) is intended for use to mark a succession of two or more bends, that are separated by

tangent distances of less than 175 m.

d. The Reverse Bend sign (W 1-4) is intended for use to mark two bends in opposite directions.

e. If the first bend is to the right, a Right Dangerous Bends sign shall be used, and if the first bend is to the left, a Left Dangerous Bends sign shall be used.

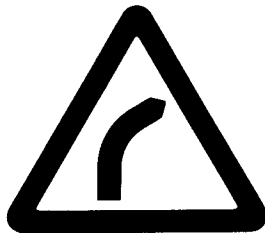
f. If the Dangerous Bends sign is used, it shall be erected in advance of the first bend.

g. Where fewer than five bends occur in succession, one or more Bend signs (W 1-1) shall be used in lieu of the Dangerous Bends sign (W 1-3).

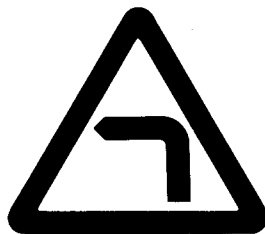
h. Additional protection may be provided by the use of a suggested speed plate posted below these signs.



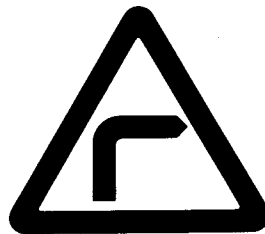
Left Bend  
W1-1L



Right Bend  
W1-1R



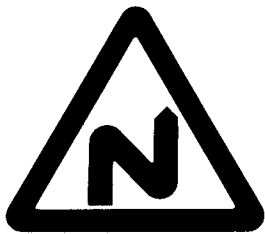
Sharp Bend  
W 1-2L



Sharp Bend  
W 1-2R



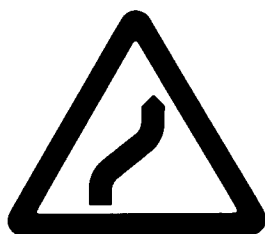
Dangerous Bends L-R  
W 1-3L



Dangerous Bends R-L  
W 1-3R



Reverse Bend L-R  
W 1-4L



Reverse Bend R-L  
W 1-4R

## 2. Steep Descent or Ascent Sign (W 2)

a. Intended for use in advance of a down-grade or upgrade where the length, percent of grade, horizontal curvature, or other physical features require drivers to take special precautions.

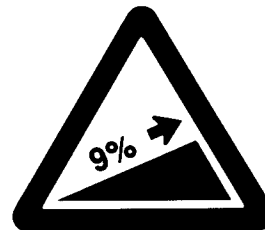
b. These signs shall be used in advance of descents or ascents for grades over 5 percent.

c. A supplemental plate may be placed underneath the sign(s) which will show the length, or distance of the descent or ascent. If a pronounced variance in grades exist in

a given section of highway, then additional sets of signs shall be used with the appropriate distance at which that grade will be encountered.



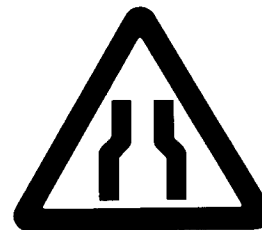
Descent  
W 2-1



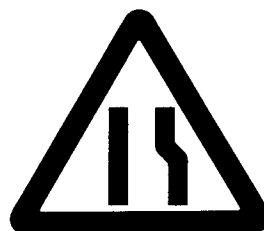
Ascent  
W 2-2

## 3. Road Narrows Sign (W 3)

Intended for use to warn drivers of the reduction in the number of traffic lanes in the direction of travel on a multi-lane road. The varied symbols show the outline of the road more clearly.



Road Narrows  
W 3-1



Road Narrows—Keep Left  
W 3-2



Road Narrows—Keep Right  
W 3-3

**4. Road Leads to Quay or River Bank Sign (W 4-1)**

Intended for use to give warning the road leads onto a quay or a river bank.



Road Leads to Quay  
or River Bank  
W 4-1

**5. Rough Road: Bad Condition Sign (W 5-1)**

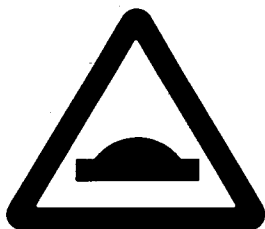
Intended for use to give warning the highway is in bad condition.



Rough Road  
W 5-1

**6. Uneven Road: Hump Bridge or Ridge Sign (W 6-1)**

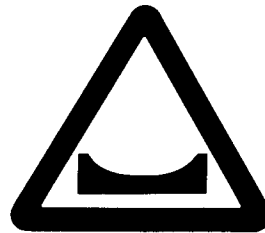
Intended for use to give warning a hump bridge or ridge exists.



Hump  
W 6-1

**7. Dip Sign (W 7-1)**

Intended for use to give warning a dip occurs in the road.



Dip  
W 7-1

**8. Slippery Road Sign (W 8-1)**

Intended for use to give warning the section of road ahead may be particularly slippery when wet. This sign shall be located in advance of the beginning of the slippery section and at appropriate intervals on long sections of such pavements.



Slippery Road  
W 8-1

**9. Loose Gravel Sign (W 9-1)**

Intended for use to give warning that a driver's vehicle may cause loose gravel to be thrown up on other vehicles in the immediate vicinity.



Loose Gravel  
W 9-1

### 10. Falling Rocks Sign (W 10-1)

Intended for use to give warning of a section of road where danger from falling rocks exists and the consequent presence of rocks on the highway.



Falling Rocks  
W 10-1

### 12. Children Sign (W 12)

Intended for use to give warning of a section of road frequented by children, such as at the exit from a school or a playground. The W 12-1 sign shall be used as an advance warning sign. If children are crossing at a marked crosswalk, a supplementary sign can be used illustrating the crosswalk lines on the sign. This supplementary sign shall be located immediately adjacent to the crossing location.



Children  
W 12-1



Children Crossing  
W 12-2

### 11. Pedestrian Crossing Sign (W 11)

Intended for use to give warning of an established pedestrian crossing zone. If used as an advance sign, no simulated crosswalk marking will appear on the sign face. When the sign illustrates crosswalk lines on the symbol plate, it is to be used as a supplementary sign to the advance sign and is to be located immediately adjacent to the crossing location. When the two-sign set is used, the crossing shall be defined by pavement markings.



Pedestrian Crossing  
W 11-1



Pedestrian Crossing  
W 11-2

### 13. Cyclists Sign (W 13-1)

Intended for use to give warning of a point where cyclists frequently enter or cross the road. If the approach to an intersection is controlled by a traffic control signal, STOP sign, or Give Way sign, this sign may not be needed.



Cyclists  
W 13-1

#### 14. Animals Crossing Sign (W 14)

Intended for use to give warning of the danger of animals crossing the road. The symbol should represent the animal, either domestic or wild, most frequently encountered in a given section. Examples of domestic animals are donkeys, sheep, goats, horses, and camels. Posting for crossings of wild animals shall be determined on the basis of need.



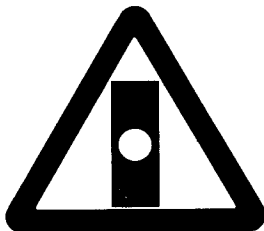
Animal Crossing  
W 14



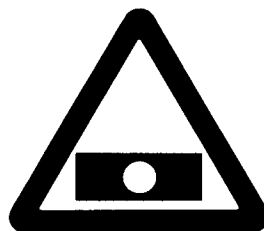
Animal Crossing  
W 14

#### 15. Signals Ahead Sign (W 15)

Intended for use in advance of any traffic control signal location where physical conditions prevent drivers from having a continuous view of at least two signal indications. Also, it should be used at a location where road users would not expect such an installation. The symbol on the sign shall be in the three colors of signal lights the driver is approaching. The arrangement of the colors may be vertical or horizontal.



Signals Ahead  
W 15



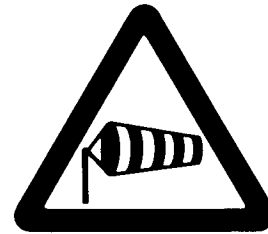
Signals Ahead  
W 15

#### 16. Low Flying Aircraft Sign (W 16-1)

Intended for use to give warning of aircraft flying over sections of road at low altitude, when taking off or landing at an airport.



Airport  
W 16-1



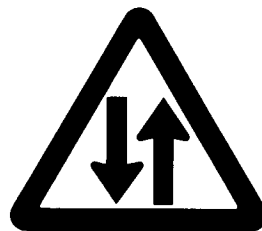
Crosswind  
W 17-1

#### 17. Crosswind Sign (W 17-1)

Intended for use to give warning that a strong crosswind often affects a driver's control of a vehicle in this section of the road.

#### 18. Two-Way Traffic Sign (W 18-1)

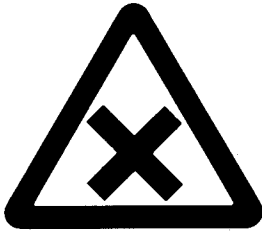
Intended for use to give warning that a one-way road (or highway comprised of several one-way traffic roadways) is changing temporarily or permanently to carrying two-way traffic on the same roadway. This sign should be used as required at intervals to periodically remind drivers they are on a two-way roadway.



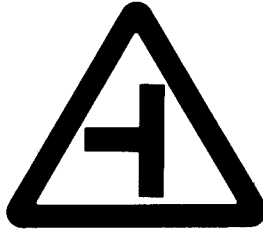
Two-Way Traffic  
W 18-1

### 19. Approach to Intersection Sign (W 19)

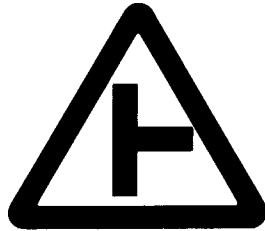
Intended for use to give warning of an intersection for the road user. Other symbols may be used to show the nature of the intersection more clearly.



Cross Road  
W 19-1



Side Road  
W 19-2



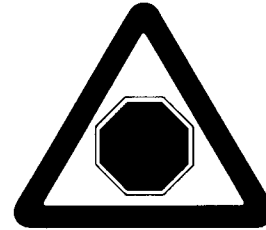
Side Road  
W 19-3

**Note:** Other appropriate symbols which accurately show the highway conditions may be used on these Warning signs. These symbols shall show the same proportions as illustrated above.

### 20. Stop Ahead Sign (W 20-1)

a. Intended for use on an approach to a STOP sign not visible for a sufficient distance to permit the driver to stop his vehicle at the STOP sign. Obstruction(s) causing the limited visibility may be permanent or intermittent.

b. In some cases, the Stop Ahead sign may be used for emphasis where the STOP sign is poorly observed.

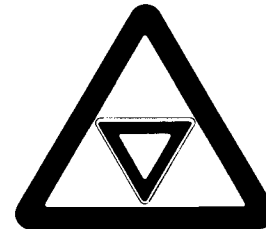


Stop Ahead  
W 20-1

### 21. Give Way Ahead Sign (W 21-1)

a. Intended for use on an approach to a Give Way sign not visible for a sufficient distance to permit the driver to stop his vehicle at the Give Way sign. Obstruction(s) causing the limited visibility may be permanent or intermittent.

b. In some cases, the Give Way Ahead sign may be used for emphasis where the Give Way sign is poorly observed.



Give Way Ahead  
W 21-1

## 22. Traffic Rotary Sign (W 22-1)

- Intended to warn by means of arrow indications that traffic keeps to the right.
- The roundabout is a circular roadway design with multiple entrances and exits, which create separate potential vehicle conflicts. Diagrammatic Informative signs showing the configuration of the roundabout should precede this Warning sign.



Traffic Rotary  
W 22-1

## 24. Dangerous Shoulder Sign (W 25-1)

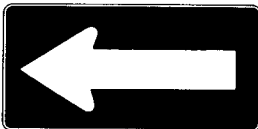
- Intended to warn of a shoulder condition that presents a hazard to vehicles which may get off the pavement.
- One sign shall be placed near the beginning of the soft-shoulder or shoulder drop-off condition, and other signs shall be placed at intervals throughout the length of the road where the condition exists.



Dangerous Shoulder  
W 25-1

## 23. Large Arrow Sign (W 24)

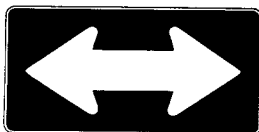
- Intended to be used to give notice of a sharp change of alignment in the direction of travel. It is not to be used where no change occurs in the direction of travel (ends of medians, center piers, etc.).
- This sign shall be a horizontal rectangle with a standard size of 1200 mm by 600 mm, with a single large arrow or double head arrow.
- This sign, when used, shall be erected on the outside of a bend or on the far side of an intersection, in line with and at right angles to approaching traffic.
- To be effective, the Large Arrow sign should be visible for at least 150 m and trial runs by day and night may be desirable to determine final positioning.



Left Arrow  
W 24-1  
1200x600



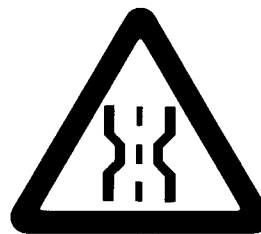
Right Arrow  
W 24-2  
1200x600



Double Arrow  
W 24-3  
1200x600

## 25. Narrow Bridge Sign (W 26-1)

Intended to warn of a structure having a curb-to-curb two-way roadway width of 5 m to 5.5 m or any bridge or culvert having a roadway clearance less than the width of the approach pavement. Additional protection should be provided by the use of object markers, delineators, and pavement markings. Bridges or culverts having less than a 6 m span and the above width also shall be treated as narrow bridges and shall be signed and delineated accordingly.



Narrow Bridge  
W 26-1

Advance signing is needed to warn approaching drivers of the specific hazard. This can be done by installing a Narrow Bridge symbol Warning sign or a One-Lane symbol Warning sign at about 800 m in advance of the narrow structure. Depending on the degree of hazard, two advance Warning signs, one located 2 km and another located at 800 m in advance of the structure, may be warranted in special cases.

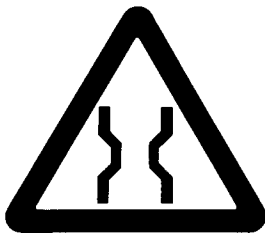
## 26. One-Lane Bridge Sign (W 27-1)

a. Intended for use on two-way roadways to warn of a structure where the following conditions occur:

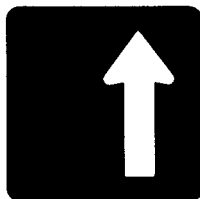
- (1) A curb-to-curb roadway width of less than 5 m.
- (2) A clear roadway width of less than 5.5 m when trucks constitute a high proportion of the traffic.
- (3) When the alignment is poor on the approach to a structure having a clear roadway width of 5.5 m or less.

b. Additional protection should be provided by the use of object markers, delineators and pavement markings.

c. In the case of the One-Lane Bridge sign, a supplemental Informative sign (I 10-1) may be used to indicate priority movement. The white arrow, indicating the direction having priority, shall point upward and the other arrow (red) shall point downward. Should the regulation of one-way traffic be required, the Priority Over Oncoming Traffic sign (R-12-1) may be used.



One-Lane Bridge  
W 27-1



Priority Over  
Oncoming Traffic  
I 10-1

## 27. Suggested Speed Plate Sign (W 28-1)

a. Intended for use to supplement Warning signs. The standard size of the Suggested Speed plate shall be 450 mm by 900 mm. Suggested Speed plates used with 900 mm and larger Warning signs shall be 600 mm by 1100 mm.

b. The plate shall carry the message (65) km/h in black on a white background. The speed shall be shown in multiples of 10 kilometers per hour but always ending in the Arabic numeral five. The plate may be used in conjunction with any standard Warning sign to indicate the maximum recommended speed at a hazardous location. It shall not be used in conjunction with any other sign, nor shall it be used



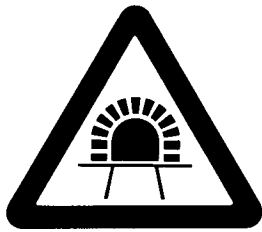
Suggested Speed  
W 28-1

alone. When used it shall be mounted on the same assembly and below the standard Warning sign.

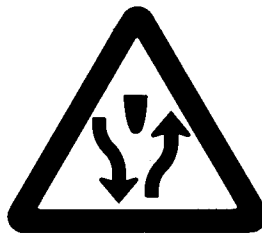
c. This sign shall not be erected until the recommended speed has been determined by accepted traffic engineering procedures. Because changes in surface characteristics, sight distance, etc. may alter the recommended speed, each location should be periodically checked and the speed plate corrected if necessary.

## 28. Tunnel Sign (W 29-1)

This sign shall be placed in advance of a tunnel entrance (portal) to inform the driver extra care should be used when traveling through the tunnel. When the tunnel is more than 75 m in length, an Informative sign should follow this sign carrying the message, "Turn on Lights" (I 7-1).



Tunnel  
W 29-1



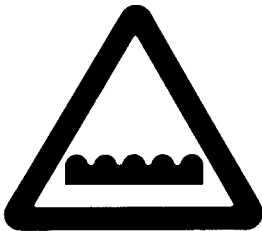
Divided Road Begins  
W 31-1



Divided Road Ends  
W 32-1

### 29. Rumble Strip (Jiggle Bars) Sign (W 30-1)

- This sign may be placed in advance of a pavement section that has a series of raised strips, which have been installed in accordance with the approved standard.
- These strips are placed at (1) approaches to towns to complement step-down speed zones, (2) approaches to



Rumble Strip  
W 30-1

### 31. Divided Highway (Road) Ends Sign (W 32-1)

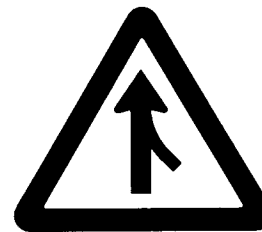
Intended for use at the end of a section of physically divided highway (not an intersection or a junction), as a warning of two-way traffic ahead.

### 32. Merge Sign (W 33)

- Intended for use to warn motorists merging movements may be encountered in advance of a point where two roadways converge and no turning conflict occurs.
- The sign should be erected on the side of the major roadway where merging traffic will be encountered and in a position not to obstruct the driver's view of vehicles on the entering roadway.
- Where two roadways of approximately equal importance converge, a sign should be placed on each roadway.



Merge  
W 33-1



Merge  
W 33-2

STOP signs where the sign is not readily discernable, and (3) at other locations where deemed desirable.

### 30. Divided Highway (Road) Sign (W 31-1)

Intended for use on the approaches to a section of highway (not an intersection or junction) where the opposing flows of traffic are separated by a physical barrier.

### 33. Low Clearance Sign (W 35-1)

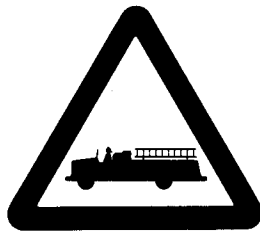
- a. Intended to warn vehicle operators of clearances less than the maximum vehicle height permitted plus 300 mm. It shall be erected in advance of the structure having the restricted clearance.
- b. Where the clearance is less than the legal limit, a sign to that effect should be placed at the nearest intersecting road or a wide point in the road at which a vehicle can detour or turn around. The Regulatory sign R 7-2 should be placed on each structure with clearance restrictions.
- c. In the case of an arch or other structure under which the clearance varies greatly, two or more signs should be used as necessary on the structure itself, to give information as to the clearance over the entire roadway.



Low Clearance  
W 35-1

### 34. Fire Station Sign (W 36-1)

- a. Intended to warn motorists a fire station is located adjacent, or in close proximity, to the highway, and they may encounter the fire equipment entering the highway on an emergency run.



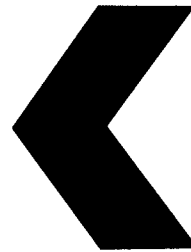
Fire Station  
W 36-1

b. The sign should be installed regardless of whether or not an emergency traffic signal is in place.

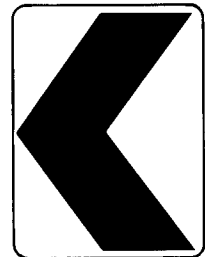
- c. If an emergency traffic signal is used, then the sign should be equipped with a hazard identification beacon which shall be actuated from a nonilluminated condition at the same time as the emergency traffic signal is changed to steady yellow (See Section 4.05).

### 35. Chevron Alignment Sign (W 37-1)

- a. Type A is to be used in Work Areas.
- b. Type B is intended to provide additional emphasis and guidance for vehicle operators to changes in the horizontal alignment of the roadway.



Type A



Type B

Chevron Alignment  
W 37-1  
450x600

### 36. Other Warning Signs

Warning signs other than those specified may be required under special conditions. Such signs shall conform with the general specifications for shape, color, and placement of Warning signs.



## 2.03 Regulatory Signs

### A. Application of Regulatory Signs

1. Regulatory signs inform highway users of various restrictions indicating the applicability of legal requirements which would not otherwise be apparent. These signs shall be erected whenever needed to fulfill this purpose and shall be erected at those locations where restrictions apply.
2. The sign message shall clearly indicate the requirements imposed by the restriction and shall be easily visible and legible to the vehicle operator.
3. Regulatory signs may be accompanied by an educational plaque, in Arabic, placed below the symbol sign.

### B. Classification of Regulatory Signs

These signs are classified in the following groups:

1. Right-of-way series.
  - a. STOP Sign.
  - b. Give Way Sign.
2. Speed series.
3. Movement and Exclusion series.
4. Parking series.
5. Mandatory series.

### C. Design of Regulatory Signs

1. These signs are round.
  - a. Speed, Movement, Exclusion and Parking series signs have a black legend on a white background and a red border.

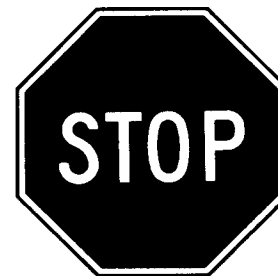
A red diagonal slash indicates a total prohibition for the condition illustrated. No red slash indicates only the condition shown.
  - b. Mandatory series signs have a white legend on a blue background.
  - c. Special Prohibitions Imposed on Moving Vehicles signs have a black rim containing a dark gray diagonal band and message. The remainder of the background is white.
2. The exceptions to the standard shape and color are with the STOP sign and the Give Way sign, respectively. The STOP sign is an octagonal shape having a red background with white border and message. The Give Way sign is an equilateral triangle with one point downward. The background color is white and the border is red.
3. All Regulatory signs shall be reflectorized or internally illuminated to show the same

shape and color both by day and night.

### D. Sign Designations, Usage and Dimensions

#### 1. STOP Sign (R 1-1)

- a. This sign shall be octagonal and shall bear the word message, STOP, in Arabic only. This sign is intended for use where traffic is required to stop.
- b. A STOP sign may be warranted at an intersection where one or more of the following conditions exist:
  - (1) Intersection of a less important road with a main road where application of the general right-of-way rule is unduly hazardous.
  - (2) Unsignalized intersection on a street having signals at other nearby intersections.
  - (3) Other intersections where a combination of high speed, restricted view, and serious accident record indicate a need for control by the STOP sign.
- c. STOP signs shall not be erected at intersections where traffic control signals are operating. STOP signs may, however, be used to control unsignalized, separated right-turn lanes.
- d. STOP signs shall not be erected indiscriminately at intersections. Allowing STOP signs at such crossings tends to lessen compliance at locations where the signs are completely compatible with the condition they are covering.
- e. Portable or part-time STOP signs shall not be used, except for maintenance or emergency purposes.
- f. STOP signs shall not be used for speed control.



Stop  
R 1-1  
900x900

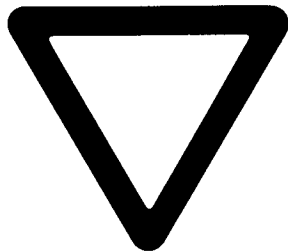
#### 2. Give Way Sign (R 2-1)

- a. This sign shall bear no symbol or inscription. Its shape indicates the approaching driver must yield to traffic on other approaches to an intersection. Vehi-

cles controlled by a Give Way sign shall stop when necessary to avoid interference with traffic which has the right-of-way.

b. The Give Way sign may be warranted:

- (1) On a minor road at the entrance to an intersection where it is necessary to assign right-of-way to the major road (but a stop is not necessary at all times) and where the safe approach speed on the minor road exceeds 20 km/h.
- (2) On the entrance ramp to an expressway, or arterial street or highway.
- (3) Within an intersection with a divided roadway where a STOP sign is present at the entrance of the first roadway, and further control is necessary at the entrance to the second roadway, and where the median width between the two roadways exceeds 10 m.
- (4) To control vehicles on a separate or channelized right-turn lane, without an adequate acceleration lane.
- (5) At any intersection where a special problem exists and an engineering study indicates the problem can be corrected by the Give Way sign.



Give Way  
R 2-1  
900x900x900

### 3. Maximum Speed Limit Signs (R 3-1)

a. The Speed Limit sign shall display the limit established by the proper authority, after an engineering and traffic investigation has been made in accordance with established traffic engineering practices.

b. The following factors should be considered to determine the proper numerical value for a speed limit, based on the engineering and traffic investigation:

- (1) Road surface characteristics, shoulder condition, grade, alignment, and sight distance.
- (2) The 85 percentile speed and pace speed.
- (3) Roadside development and culture, and roadside friction.
- (4) Safe speed for curves or hazardous locations.

(5) Parking practices and pedestrian activity.

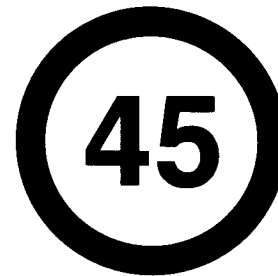
(6) Reported accident experience for a recent 12-month period.

c. This sign gives notification of a speed limit. The Arabic figure(s) appearing on the sign shall indicate to the nearest 10 km/h, the maximum speed but always ending in Arabic numeral five.

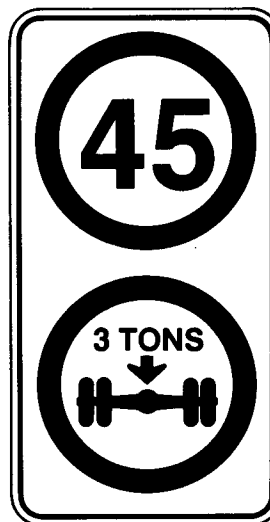
d. To indicate a speed limit applicable only to trucks (R 22-1) or to vehicles weighing more than a specified amount (R 7-4), an inscription comprising that specified amount shall be placed on an additional panel below the sign.



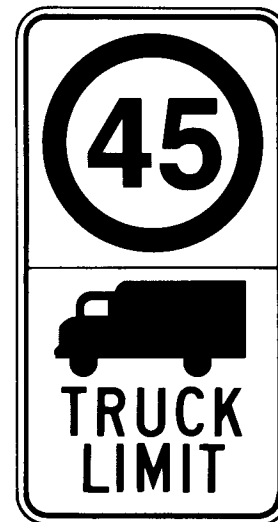
Speed Limit  
R 3-1  
900 Diameter



Speed Limit  
R 3-1  
900 Diameter



Speed Limit—Vehicles  
Weighing More than Amount  
R 3-1/7-4  
900x1800

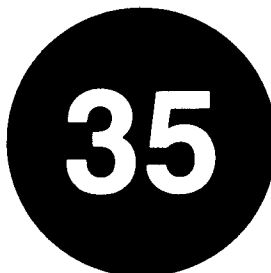


Truck Speed Limit  
R 3-1/22-1  
900x1800

e. The exit speed signs are intended for use where engineering investigations of roadway, geometric, or operating conditions show the necessity of advising drivers of the maximum recommended speed on a ramp. The sign should be posted along the deceleration lane or along the ramp so it is visible in time for the driver to make a safe slowing and exiting maneuver. Where an additional speed indication is needed on the ramp well beyond the gore, a standard Warning sign with a Suggested Speed plate is to be used.

#### 4. Compulsory Minimum Speed and End of Compulsory Minimum Speed Signs (R 4)

- a. This sign is placed at the entrance of the highway notifying drivers to travel at not less than the speed specified (R 4-1).
- b. The End of Compulsory Minimum Speed sign means the compulsory minimum imposed by sign R 4-1 is no longer in effect. This sign is identical to sign R 4-1, except that it shall be crossed by an oblique red bar running from the upper right edge to the lower left edge (R 4-2).



Compulsory Minimum  
R 4-1  
900 Diameter



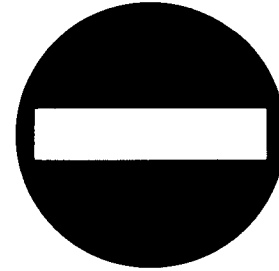
End Compulsory  
Minimum Speed  
R 4-2  
900 Diameter

#### 5. Entry Prohibited Sign (R 5-1)

- a. This sign is a red disk with a white horizontal bar.
- b. This sign gives notification that entry by all vehicles is prohibited.
- c. To prohibit traffic from entering a restricted road section, the Entry Prohibited sign should be conspicuously placed in the most appropriate position at the exit from a one-way roadway or ramp. The sign should normally be mounted on the right-hand side of the roadway, but a second sign on the left-hand side of the roadway may be justified for additional emphasis.

d. The Entry Prohibited sign should be used to mark roads closed to all traffic (except authorized vehicles) because of work area operations or a temporary emergency. It should not be used where traffic is maintained or a route is detoured several kilometers in advance of the actual construction or blockage.

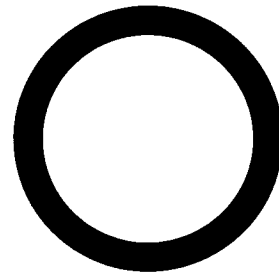
e. Where the sign faces through traffic, it shall be preceded by an Advance Road Closed Warning sign, and if applicable, an Advance Detour Warning sign (See Part 5).



Entry Prohibited  
R 5-1  
900 Diameter

#### 6. Closed to All Vehicles in Both Directions Sign (R 6-1)

This sign is an open circle and bears no symbols. This sign gives notification all vehicular traffic is prohibited in both directions.



Closed Both  
Directions  
R 6-1  
900 Diameter

#### 7. No Entry by Any Vehicle Except Two-Wheeled Motorcycles Without a Side Car Sign (R 6-2)

This sign gives notification only two-wheeled motorcycles (without side cars) are permitted to enter. All other power-driven vehicles are prohibited. Silhouette indicates vehicle whose entry is prohibited.



Motorcycles Only  
**R 6-2**  
900 Diameter

### 8. No Entry by Motorcycles Sign (R 6-3)

This sign gives notification that entry by all motorcycles is prohibited. Silhouette indicates vehicle whose entry is prohibited.



Motorcycles  
Prohibited  
**R 6-3**  
900 Diameter

### 9. No Entry by Cycles Sign (R 6-4)

This sign gives notification that entry by cycles is prohibited. Silhouette indicates conveyance whose entry is prohibited.



Cycles Prohibited  
**R 6-4**  
900 Diameter

### 10. No Entry by Mopeds Sign (R 6-5)

This sign gives notification that entry by mopeds is prohibited. Silhouette indicates vehicle whose entry is prohibited.



Mopeds Prohibited  
**R 6-5**  
900 Diameter

### 11. No Entry by Goods Vehicles Sign (R 6-6)

a. This sign gives notification that entry by goods vehicles is prohibited. Silhouette indicates vehicle whose entry is prohibited.

b. The inscription consists of a tonnage figure, either in a light color on the silhouette of the vehicle or on an additional panel placed below the sign. This means the prohibition shall apply only if the permissible maximum weight of the vehicle or combination of vehicles exceeds that figure.

c. A red slash is used when all goods vehicles are prohibited. When a tonnage figure (3 tons) is placed on the sign to indicate a prohibition for vehicles exceeding that weight, no slash is to be used.



Goods Vehicles  
Prohibited  
**R 6-6**  
900 Diameter

**12. No Entry by Any Power-Driven Vehicle Drawing a Trailer Other Than a Semi-Trailer or a Single-Axle Trailer Sign (R 6-7)**

a. This sign gives notification that entry by any power-driven vehicle drawing a trailer other than a semi-trailer or a single-axle trailer is prohibited. Silhouette indicates vehicle whose entry is prohibited.

b. The inscription is a tonnage figure, either in a light color on the silhouette of the trailer or on an additional panel placed below the sign. It shall mean the prohibition applies only if the permissible weight of the trailer exceeds that figure.



Drawn Trailer  
Prohibited  
R 6-7  
900 Diameter

**13. No Entry by Pedestrians Sign (R 6-8)**

This sign gives notification that entry by pedestrians is prohibited. Silhouette indicates a walking pedestrian whose entry is prohibited.



Pedestrian  
Prohibited  
R 6-8  
900 Diameter

**14. No Entry by Animal-Drawn Vehicles Sign (R 6-9)**

This sign gives notification that entry by animal-drawn vehicles is prohibited. Sil-

houette indicates the type of conveyance and the animal.



Animal Carts  
Prohibited  
R 6-9  
900 Diameter



Hand Carts  
Prohibited  
R 6-10  
900 Diameter

**15. No Entry by Handcarts Sign (R 6-10)**

This sign gives notification that entry by handcarts is prohibited. Silhouette indicates the general type of cart.

**16. No Entry by Power-Driven Agricultural Vehicles Sign (R 6-11)**

This sign gives notification that entry by agricultural vehicles is prohibited. Silhouette indicates a tractor or other agricultural vehicle.



Farm Equipment  
Prohibited  
R 6-11  
900 Diameter

**17. No Entry by Power-Driven Vehicles Sign (R 6-12)**

This sign gives notification that entry by power-driven vehicles is prohibited. Silhouette indicates the classes of vehicles in this category. Signs showing more than two silhouettes may not be set up outside built-up areas.



Motor Vehicles  
Prohibited  
**R 6-12**  
900 Diameter



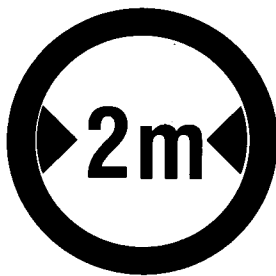
All Vehicles  
Prohibited  
**R 6-13**  
900 Diameter

### 18. No Entry by Power-Driven Vehicles or Animal-Drawn Vehicles Sign (R 6-13)

This sign gives notification that entry by power-driven or animal-drawn vehicles is prohibited. Silhouette indicates classes of vehicles and conveyances in this category. Signs showing more than three silhouettes may not be set up in built-up areas.

### 19. No Entry by Vehicles Having an Overall Width Exceeding ( ) Meters Sign (R 7-1)

This sign gives notification of prohibition of vehicles with widths exceeding ( ) meters. The sign illustrates the number of meters, and that the measurement is horizontal.



Restricted Clearance  
**R 7-1**  
900 Diameter



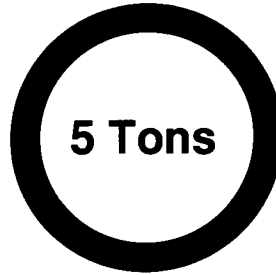
Restricted Clearance  
**R 7-2**  
900 Diameter

### 20. No Entry by Vehicles Having an Overall Height Exceeding ( ) Meters Sign (R 7-2)

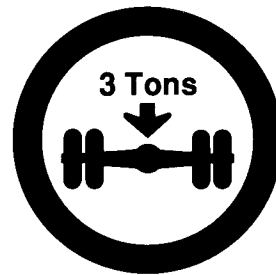
This sign gives notification of prohibition of vehicles with heights exceeding ( ) meters, and illustrates the maximum height in meters. These signs should be placed on entrances to facilities with clearance restrictions. Also, these signs should be placed on each structure with clearance restrictions.

### 21. No Entry by Vehicles Exceeding ( ) Tons Laden Weight Sign (R 7-3)

This sign gives notification of prohibition of vehicles exceeding ( ) tons laden weight. The sign illustrates the number of tons and an insignia for tons.



Restricted Loads  
**R 7-3**  
900 Diameter



Restricted Loads  
**R 7-4**  
900 Diameter

### 22. No Entry by Vehicles Having a Weight Exceeding ( ) Tons on One Axle Sign (R 7-4)

a. The sign gives notification of prohibition of vehicles having a weight exceeding ( ) tons on any one axle.

b. The sign illustrates an axle, a downward arrow, and an insignia for tons.

### 23. No Entry by Vehicles or Combinations of Vehicles Exceeding ( ) Meters in Length Sign (R 7-5)

This sign gives notification of prohibition of vehicles or combinations of vehicles exceeding ( ) meters in length. The sign illustrates a vehicle, number of meters, and that the measurement is horizontal.



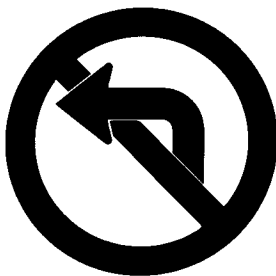
Long Vehicles  
Prohibited  
**R 7-5**  
900 Diameter

#### 24. No (Left) (Right) (U) Turn Signs (R 8)

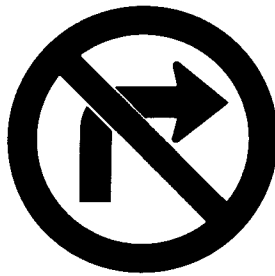
a. This sign gives notification that turning is prohibited (either to the left or to the right). The turn arrow appears with an oblique red bar.

b. The sign should be placed where it will be most easily seen by drivers intending to turn.

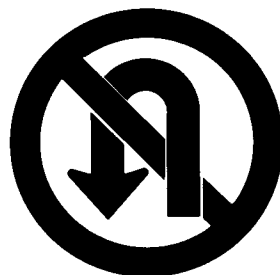
c. The No U-Turn sign gives notification U-turns are prohibited. The U-turn arrow appears with an oblique red bar. The signs are to be used at or between intersections on highways, where such a maneuver is prohibited by regulation.



No Left Turn  
R 8-1  
900 Diameter



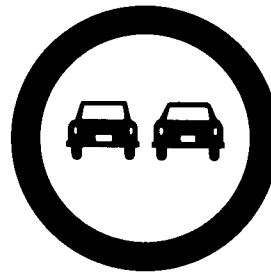
No Right Turn  
R 8-2  
900 Diameter



No U Turn  
R 8-3  
900 Diameter

#### 25. Overtaking Prohibited Sign (R 9-1)

This sign gives notification of the general rules on overtaking established by the regulations of the Kingdom. In addition, it shows that the overtaking of power-driven vehicles other than two-wheeled mopeds and two-wheeled motorcycles without side cars is prohibited. Silhouettes illustrate two vehicles side by side, the one on the right side in black and on the left side (passing side) in red.



Overtaking  
Prohibited  
R 9-1  
900 Diameter



Overtaking by  
Trucks Prohibited  
R 9-2  
900 Diameter

#### 26. Overtaking by Goods Vehicles Prohibited Sign (R 9-2)

a. This sign gives notification goods vehicles exceeding ( ) tons are prohibited from overtaking other vehicles.

b. Silhouette illustrates two vehicles side by side, a smaller vehicle and a larger goods vehicle. The small vehicle on the right side is in black, and the larger vehicle on the left side (passing side) is in red.

#### 27. Use of Audible Warning Devices Prohibited Sign (R 10-1)

This sign, if not placed near the sign identifying the built-up area, shall be accompanied by an additional panel showing the distance over which the prohibition applies. Silhouette illustrates a horn device with an oblique red bar.



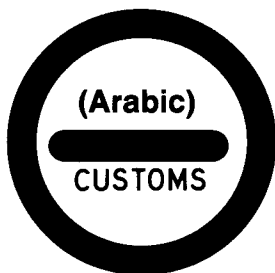
No Horns  
R 10-1  
900 Diameter

#### 28. Passing Without Stopping Prohibited Sign (R 11-1)

a. This sign gives notification of the proximity of a custom house at which a stop is compulsory. The word "Customs" should appear, preferably in two or more

languages depending on needs at any given entry point.

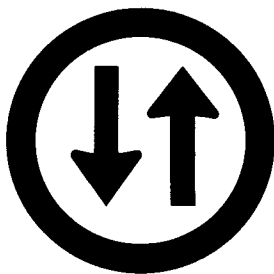
b. This sign may also be used to notify drivers that passing without stopping is prohibited for other reasons. In these cases, the word "Customs" shall be replaced by another brief inscription indicating the reason for the required stop.



Customs  
R 11-1  
900 Diameter

## 29. Priority for Oncoming Traffic Sign (R 12-1)

a. On a narrow section of road where passing is difficult or impossible, traffic may have to be regulated. If drivers can clearly see the whole length of the section, by night and day, such regulations may be carried out by giving a priority to traffic moving in one direction rather than by installing traffic signals. When used, this sign shall face traffic which does not have priority. It shall mean that entry into the narrow section is prohibited so long as it is not possible to pass through that section without requiring oncoming vehicles to come to a stop.

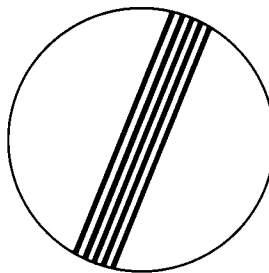


Priority for  
Oncoming Traffic  
R 12-1  
900 Diameter

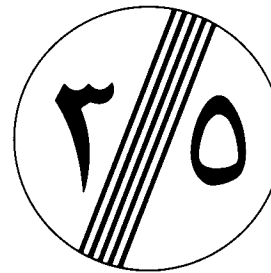
b. The arrow indicating the direction having priority shall be black, and the arrow indicating the other direction shall be red.

## 30. End of All Special Prohibitions Imposed on Moving Vehicles Signs (R 13)

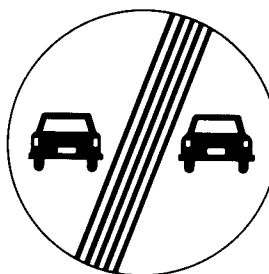
This sign shall be placed at the point where all special prohibitions imposed on moving vehicles by prohibitory signs cease to apply. Examples of these signs would be for ending a speed limit or ending prohibition for overtaking. The sign shall have a black rim and bear a diagonal band sloping downward from right to left consisting of parallel black lines.



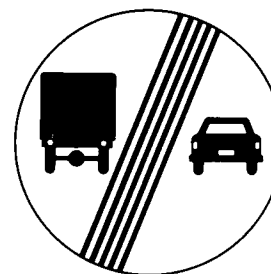
End All Prohibitions  
R 13  
900 Diameter



End Speed Limit  
R 13/3-1  
900 Diameter



End of Overtaking  
Prohibited  
R 13/9-1  
900 Diameter



End of Overtaking  
by Trucks Prohibited  
R 13/9-2  
900 Diameter

### 31. Parking Prohibited and Parking Restricted Signs (R 14)

- a. R 14-1 indicates places where parking and stopping are prohibited at all times.
- b. R 14-2 indicates places where restricted parking is available with the specific limitation being shown on a supplemental plaque mounted below the symbol sign.



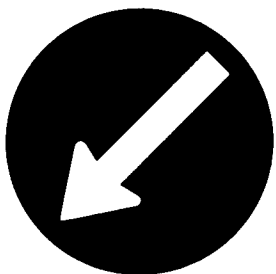
Parking and Stopping Prohibited  
R 14-1  
900 Diameter



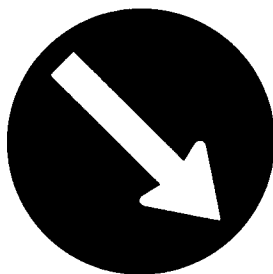
Parking Restricted  
R 14-2  
900 Diameter

### 32. Pass This Side Sign (R 15-1 and R 15-2); Pass Either Side Sign (R 15-3)

These signs are placed on an island or before an obstacle on the highway, and it means that vehicles must pass on the side(s) of the island or obstacle indicated by the arrow(s).



Pass This Side  
R 15-1  
900 Diameter



Pass This Side  
R 15-2  
900 Diameter



Pass Either Side  
R 15-3  
900 Diameter

a. These signs should be used at the ends of medians, parkways, loading islands, refuge islands, traffic islands, and at underpass piers where traffic is required to keep to the right (or left). The Pass This Side or Pass Either Side signs may not always be necessary at intermediate ends of divisional islands, and medians and should not be used with other signs that obviously mark locations where motorists know they must pass on the right.

b. These signs shall have a standard size at least 900 mm on local roads. On expressways and arterial highways, the size shall be 1200 mm. A smaller size of 600 mm is permissible for use on narrow medians at median openings to serve entering cross traffic and to remind drivers of the regulation.

c. A certain amount of flexibility must be allowed in the mounting height for Pass This Side or Pass Either Side signs. Where the obstruction is in or so near the lane of traffic that a sign at a normal minimum height may be obscured by vehicles, a second sign of the same design may be mounted above the standard sign with its bottom edge at a height of 2.5 m to 3 m above the pavement. In this case the lower sign may be placed somewhat below the normal minimum height.

d. On a median, the Pass This Side or Pass Either Side signs should be mounted not more than 15 m beyond the approach end. On a pedestrian island or intersection channelizing island, it should be mounted at the approach end or as close as practicable. The sign should be mounted on the face of or just in front of a pier or other obstruction in the center of the roadway. Where appropriate, a Pass This Side sign with the arrow pointing downward and left may be used.

### 33. One-Way Sign (R 16-1)

This Arrow symbol sign shall be used when required to indicate streets or roadways upon which vehicular traffic is allowed to travel in one direction only. The sign shall be standard, and a minimum size of 900 mm by 300 mm with either a right or left arrow.



One-Way R  
R 16-1  
900x300



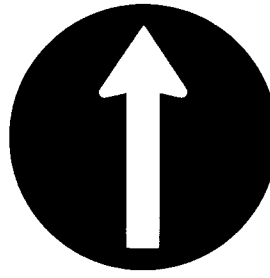
One-Way L  
R 16-1  
900x300

a. These signs shall be placed on the far right-hand and the far left-hand corners of the intersection to face traffic entering or crossing the one-way street. Where the intersection is signalized, the signs should be placed near the appropriate signal faces. One-Way signs shall also be placed parallel to the one-way street directly opposite the exits from alleys and other public ways. A One-Way sign shall always be used, where applicable, and may be supplemented by a Turn Prohibition sign (R 8).

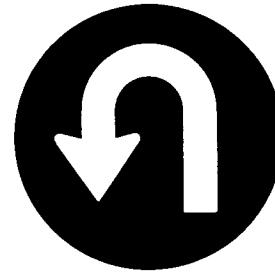
b. One-Way signs shall be placed opposite exits from major traffic generators onto divided highways or onto one-way service roads, where no median crossing occurs at that point.

### 34. Mandatory Movement (Lane-Use Control) Signs (R 17)

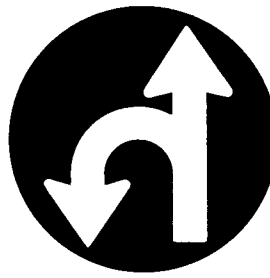
a. The signs shall have a round shape with white symbols on a blue background.



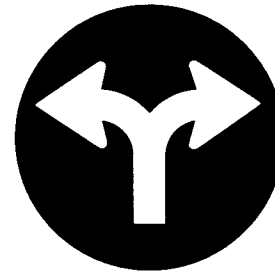
Mandatory Movement  
R 17-2  
900 Diameter



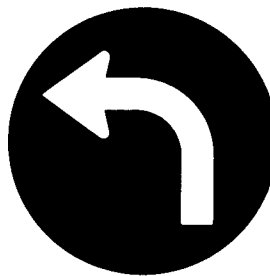
Mandatory Movement  
R 17-3  
900 Diameter



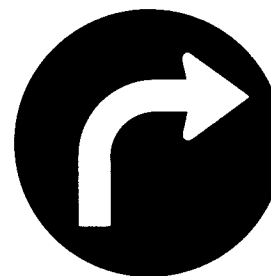
Mandatory Movement  
R 17-4  
900 Diameter



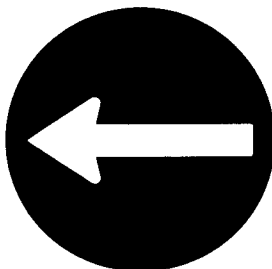
Mandatory Movement  
R 17-5  
900 Diameter



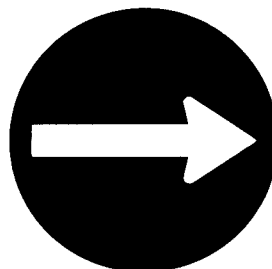
Mandatory Movement  
R 17-6L  
900 Diameter



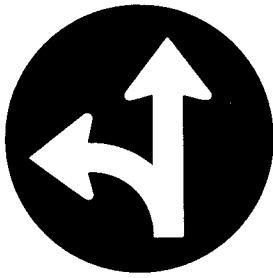
Mandatory Movement  
R 17-6R  
900 Diameter



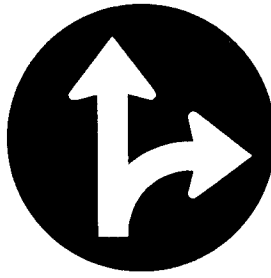
Mandatory Movement  
R 17-1L  
900 Diameter



Mandatory Movement  
R 17-1R  
900 Diameter



Mandatory Movement  
R 17-7L  
900 Diameter



Mandatory Movement  
R 17-7R  
900 Diameter

b. Mandatory signs shall be placed in the immediate vicinity of the point where the obligation begins and may be repeated if deemed necessary.

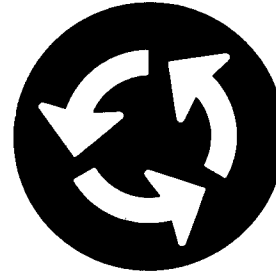
c. These signs indicate the directions to be followed at an intersection. The Mandatory Movement sign shall show a single arrow for a single movement or they shall show a straight-through and a curved arrow indicating that either of the movements is permissible.

d. Overhead Mandatory Movement signs may be used to illustrate a specific condition which may not be visible to motorists. The Mandatory Movement signs are not to be used for lane control. This control, particularly the multiple-lane turn, is needed where volumes are high and an overhead installation can be justified. Use of an overhead sign for one approach lane does not mean installation of overhead signs for the other lanes of that approach is needed.

e. When post-mounted Mandatory Movement signs are used, one sign should be placed at the intersection. A second Mandatory Movement sign should be placed at an adequate distance in advance of the intersection so motorists can select the appropriate lane before reaching the ends of the lines of waiting vehicles. Roadway markings should be used to supplement post-mounted signs and may be used with overhead signs.

### 35. Traffic Rotary Sign (R 18-1)

This sign shows the prescribed direction of movement of traffic around a rotary circle.



Traffic Rotary  
R 18-1  
900 Diameter

### 36. Cycle Path Sign (R 19-1)

This sign shall be placed at the entrance to a cycle path to notify cyclists they must use the path. The sign also notifies drivers of other vehicles they are not entitled to use the path. If permitted by the Kingdom's "Traffic Regulations," drivers of mopeds may also use the path.



Cycle Path  
R 19-1  
900 Diameter

### 37. Foot Path Sign (R 20-1)

This sign is placed at the entrance to a foot path, notifying pedestrians they must use the path. It also notifies other road users they are not allowed to use the path.



Foot Path  
R 20-1  
900 Diameter

### 38. Path for Riders on Animals Sign (R 21-1)

This sign is placed at the entrance of a path used by animal riders only and notifies other road users they are not permitted to use that path.



Ridden Animal Path  
R 21-1  
900 Diameter

## 2.04 Informative Signs

### A. General Characteristics

Informative signs should be designed to be easily readable, permitting drivers to make timely and proper responses. This means high visibility, large lettering, and short legends for quick comprehension. Standard shapes and colors are required so the signs can be promptly recognized. This group of signs includes several categories, all of which convey useful information to road users. The categories are as follows: Advance Direction signs, Direction signs, Route Marker signs, Place Identification signs, Confirmatory signs, Useful Information signs, Facility signs, and Parking signs. Certain signs will bear inscriptions in Arabic and English.

### B. Scope of Sign Standards

Standards for collector and local roads are prescribed in Section 2.05 of this Manual. Standards for expressways and for arterial highways are combined in Section 2.06 of this Manual. Collector highways call for an intermediate level of signing more advanced than prescribed for local roads, but less demanding in the requirements and specifications than expressway and arterial signing standards.

### C. Principles of Signing

1. The signing must furnish drivers with clear instructions for orderly progress to their destinations.
2. Sign installations are an integral part of the highway facility and must be planned concurrently with the development of highway location and geometric design. Plans for signing must be analyzed during the earliest stages of preliminary design and details correlated as final design is developed.
3. Informative signs may be used to show Kingdom, province, city, and village jurisdictional boundaries. Where these signs interfere with signing for interchanges or intersections or other equally critical points, Informative signs indicating boundaries will be omitted or relocated to a more suitable position. On all such signs the design should be simple and dignified, devoid of any tendency toward advertising. The signs should be designed to look similar to all other highway signing.

### D. Functions of Informative Signs

Informative signs serve distinct functions as follows:

1. Give directions to destinations or to streets, at intersections or interchanges.
2. Furnish advance notice of the approach to intersections or interchanges.

3. Direct drivers into appropriate lanes in advance of diverging or merging movements.

4. Indicate access to general motorist services, rest, scenic, recreational areas, and holy sites.

5. Provide other information of value to the driver.

### E. Application

Informative signs are essential to guide vehicle operators along streets and highways; inform them of intersecting routes; direct them to cities, towns, villages, or other important destinations; and identify nearby geographical, geological, historical and religious points of interest. Generally, these signs are designed to give information which will help the driver along his way in the most simple, direct manner possible.

### F. Size of Signs

1. For most Informative signs the legend is so variable, no rigidly standardized sign size can be established. The sign size must be determined primarily by the length of the message, size of the lettering and spacing necessary for proper legibility. On signs with dual language messages, the letter size of the English legend shall be approximately two-thirds of the Arabic letter size. The Arabic sizes will be determined first, and the English size will be based on the Arabic sizes.

2. A sign mounted over a roadway lane may have to be limited in horizontal dimension to the width of the lane, so another sign may be placed over an adjacent lane. The necessity to maintain proper vertical clearance may place a further limitation on the size of the overhead sign and the message which can be accommodated.

### G. Size of Lettering

1. For Informative signs with varying legends, sign legibility is a direct function of letter size. The legibility distance must give the driver sufficient time to read the sign before passing it. Although under the best conditions an Informative sign message can be read in a brief glance, a reasonable safety factor must be allowed for inattention, blocking of view by other vehicles, unfavorable atmospheric conditions, inferior eyesight, or other causes for delayed or slow reading.

2. The minimum sizes specified in Table A, Appendix should be exceeded where unusual conditions indicate a need for greater legibility.

## H. Style of Lettering and Legend Spacing

1. Using standardized letter style and arrow designs helps to assure uniform and effective application. The message dimensions of all expressway and arterial highway signs shall be determined first and the outside sign dimensions secondarily.
2. All names of places, streets, and highways on Informative signs shall be in both Arabic and English. English names generally shall be composed of lower case letters with initial upper case letters. The Arabic style shall be Naskh.

## I. Amount of Legend

1. Regardless of letter size, the legend on an Informative sign must be kept to a minimum to be legible at a glance during the few moments a driver can turn his eyes from the road. Informative signs should be limited to six lines of principal legend (three lines in Arabic and three lines in English).
2. "Principal legend" refers mainly to place names, route number (if used) and street names. Symbols, action information, cardinal directions and exit numbers which make up other lines of the message should also be kept to a minimum.

## J. Abbreviations

Abbreviations are to be kept to a minimum but can be useful when destination messages are excessively long.

## K. Arrows and Symbols

1. Arrows are used on many Informative signs to indicate the directions toward designated routes or destinations. Upward pointing arrows may be pointed at any appropriate angle to convey a clear comprehension of the direction to be taken. At right-angle intersections a horizontal arrow is appropriate. On a roadside sign a directional arrow for a straight-through movement shall point upward. For a bend the arrow should be pointed upward so as to best describe the direction in which the route leaves the intersection and at an angle related to the sharpness of the bend.
2. Where a long, single panel is mounted on an overhead structure for the purpose of giving straight-through information common to all lanes, downward arrows can be used. The downward arrow should point to the lane which they pertain. (See Figure 2-5).
3. Design and application of arrows for arterial and expressway highway Informative signs shall be the same as that specified for local roads (See Figure 2-6). Sections 2.05 and 2.06 include specific information on selection of arrow configurations for the various sign applications. For added legibility, it is recommended the widths across the barbs of the arrow be at least equal to the height of the largest letters on the sign, and for short downward pointing arrows on overhead signs, about  $1\frac{3}{4}$  times the letter height.

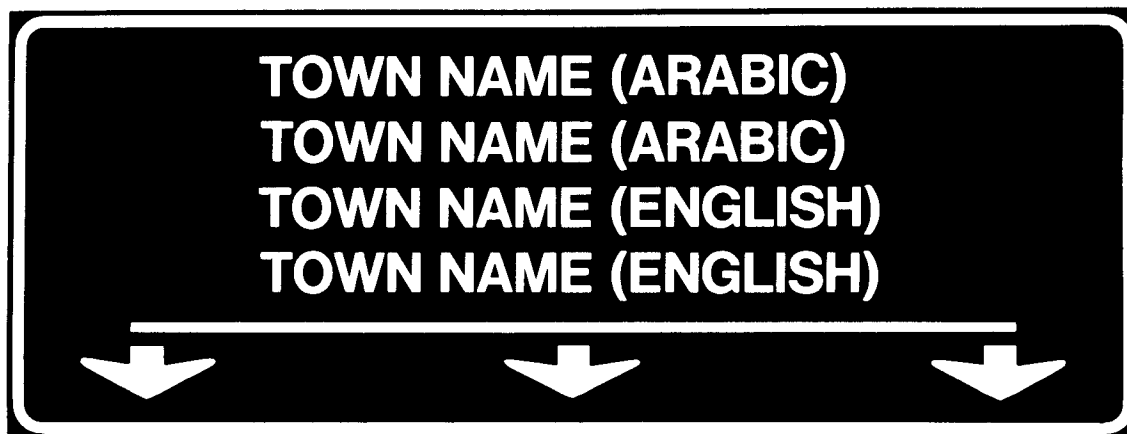
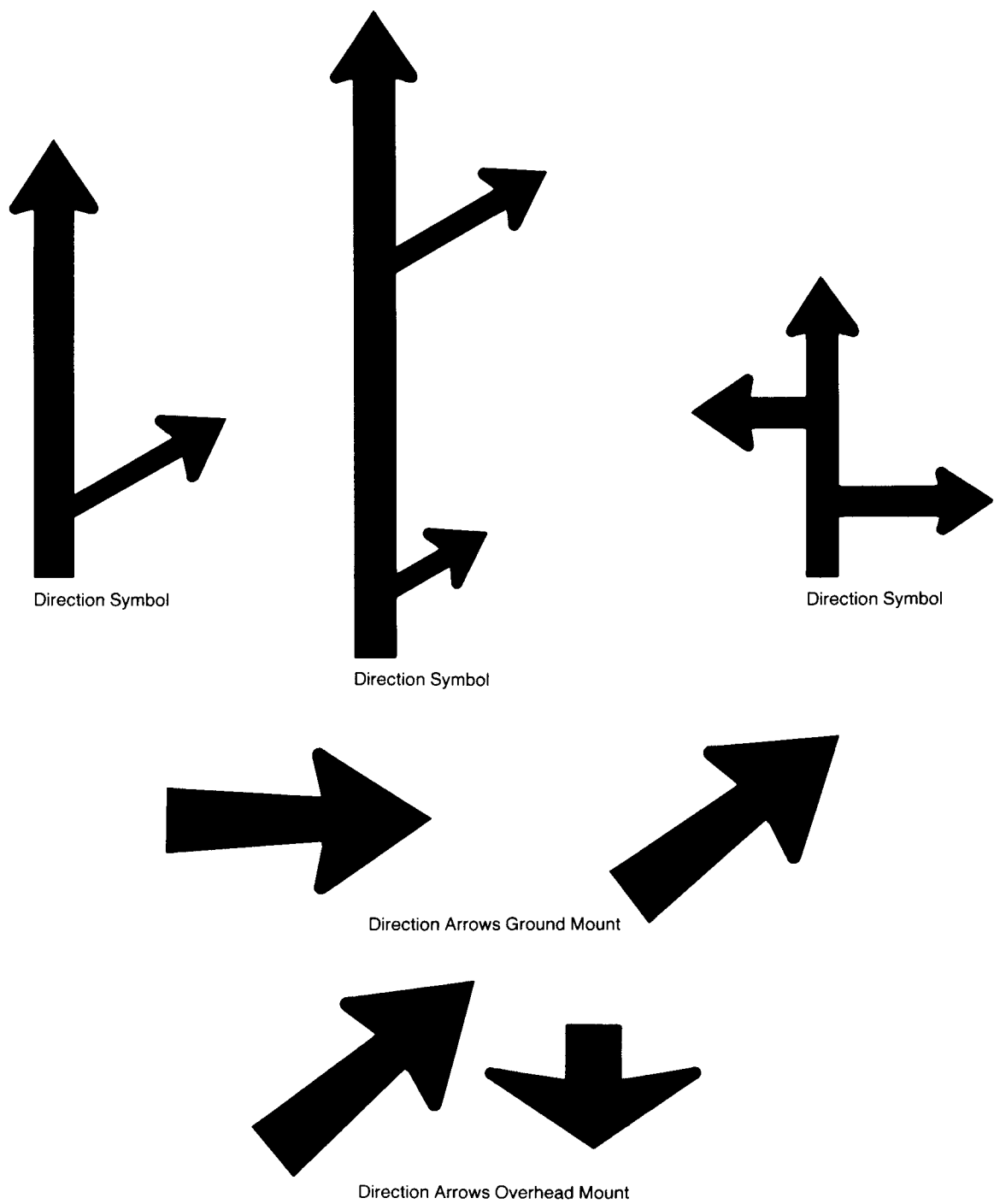


Figure 2-5  
Typical overhead informative sign showing lane assignment arrows.



**Figure 2-6**  
**Typical Informative sign arrow configurations.**

4. Arrows may be placed below the other sign legend on a separate panel or to one side of it. At an exit, an arrow should be placed at the side of the sign, which reinforces the movement of the exiting traffic.

#### **L. Interline and Edge Spacing**

1. Interline spacing of English upper case letters should be approximately three-fourths the average of upper case letter heights in adjacent lines of letters. Interline spacing of Arabic letters should be the same or greater as the letter heights in adjacent lines of letters.

2. The spacings to the top and bottom borders should be approximately equal to one-half the basic letter height of the adjacent line of letters. The lateral spacing to the vertical borders should be essentially the same as the height of the largest letter in the adjacent lines of letters.

#### **M. Sign Borders**

Signs containing destinations shall have a border of the same color as the legend, to outline their distinctive shape to make them easily recognizable and to give them a finished appearance. The border width should generally not exceed the stroke width of the Arabic lettering; however, a minimum border width of 30 mm should be used. For Informative signs larger than 2 m by 3 m, the border shall have a width of 50 mm. On unusually large signs, a border of 75 mm may be appropriate. In general, border widths should be proportional to sign size, and the corners of the sign border shall be rounded.

#### **N. Color and Reflectorization**

1. Informative signs on all highways shall have white letters, symbols, and borders on a blue background.

2. Letters, numerals, symbols, and borders shall be reflectorized as a minimum.

3. All overhead Informative signs shall be illuminated where possible.

4. Reflectorization shall be either by background reflectorization, or by using reflector button or reflective sheeting copy on an

opaque background.

#### **O. Viewing Factors**

Proper placement of signs, either overhead or at the roadside, can greatly enhance the effectiveness of an installation. Sign faces should always be oriented to minimize specular glare. Decisions on the placement of signs, both roadside and overhead should be related to site conditions. Where highway design features and other appurtenances are affected, sign placement should be jointly planned for best service and safety. Signs should be located to be seen far enough in advance to allow drivers to read and comprehend the message.

#### **P. Vertical Clearance**

1. In ground installations, directional Informative signs shall be erected at a minimum height of 2 m above the edge of the pavement to the bottom of the sign. If a sign is mounted below another sign, the major sign shall be at least 2.5 m and the secondary sign at least 1.5 m above the level of the pavement edge. (See Figure 2-1)

2. When signs are positioned a minimum of 9 m away from the pavement edge to increase roadside safety, the vertical clearance of such signs may be reduced to 1.5 m above the pavement edge. (See Figure 2-1)

#### **Q. Horizontal Clearance**

1. To provide a clear roadside recovery area for out-of-control vehicles, liberal horizontal clearances should be provided for roadside signs and overhead sign supports. In no case shall any part of the sign or the sign structure, which is within the applicable vertical clearance dimension and exposed to traffic, be less than 1 m beyond any shoulder or travel lane prepared for normal or emergency travel of vehicles.

2. Advantage should be taken of the longitudinal location of existing guardrail, overcrossing structures, and similar conditions to lessen the exposure of signs and sign supports to traffic. Breakaway or yielding supports should be located as far from the traveled portion of the roadway as feasible.



Primary  
I 1-1  
900x900 (Primary)



Other Primary and Secondary  
I 1-2  
600x600

## R. Route Markers (I 1)

1. Route markers shall be used to identify and mark all numbered highways in the Kingdom. The markers for each classification of streets and highways shall be distinctive as far as the symbol is concerned. All markers shall be square in shape with the symbol superimposed on the square. Route markers as well as any auxiliary markers which accompany the route markers shall be reflectorized. The marker symbols shall be green and white with black Naskh style numerals. Auxiliary markers shall be the same color combination of the route marker which they supplement.

2. Distinctive markers are used on the various categories of highways classified according to Highway Design Manual (HDM) Volume 1-1.05. Route numbers are assigned in accordance with that functional classification criteria. Expressway (primary system) route markers will carry a route number imposed

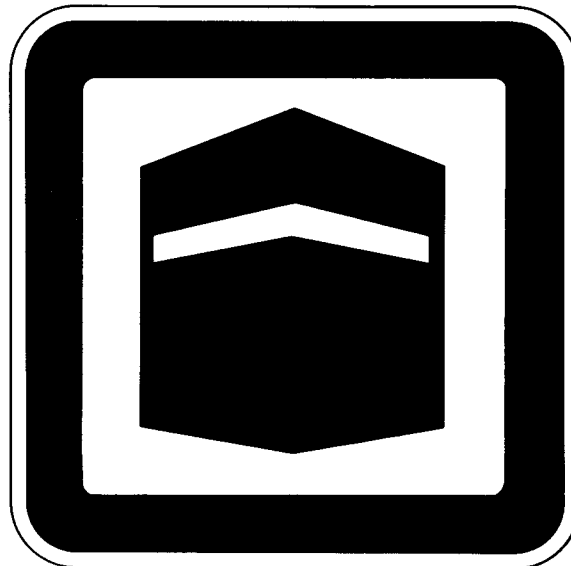
on the outline of the Arabian peninsula (Figure I 1-1) and shall be green and white. On secondary highways, the marker will be in green and white (Figure I 1-2). On feeders the symbol will be circular shaped in green and white (Figure I 1-3).

3. Route numbering selection shall use north to south and east to west directional routing and shall include even numbered designations for east and west routes and odd numbered designations for north and south routes. Cardinal direction markers shall be used as auxiliary markers with route numbering markers.

4. The MAKKAH trail marker is designed to provide pilgrims with route guidance on following a particular route to MAKKAH. It may be erected at strategic locations along major routes to indicate the direction to MAKKAH.



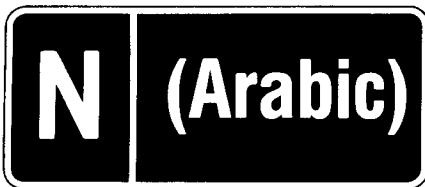
Feeders  
I 1-3  
600x600



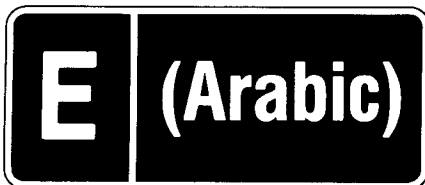
MAKKAH Trail Marker  
I 1-4  
600x600

### S. Cardinal Direction Markers (I 2)

Cardinal Direction markers shall consist of a single plate with the Arabic word for direction on the right two-thirds of the sign and the letter N, S, E, or W on the left. The two sections are divided by a vertical line. The colors shall correspond to the route markers.



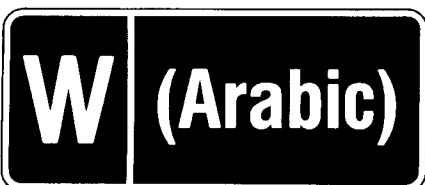
I 2-1  
600x300



I 2-2  
600x300



I 2-3  
600x300



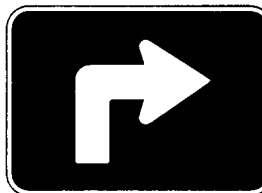
I 2-4  
600x300

### T. Advance Bend Arrow (I 3)

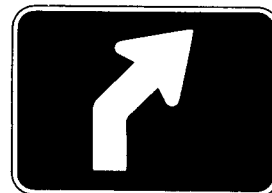
1. The Advance Bend Arrow marker displays a right or left arrow, with the shaft bent at a right angle or at a 45° angle.

2. These Advance Bend arrows are used with route markers in lieu of any junction sign. When placed below the marker, this arrow shows the direction that the route takes at its intersecting point. In some instances a vertical arrow could be used if one route continues straight through and the other route leaves at some angle.

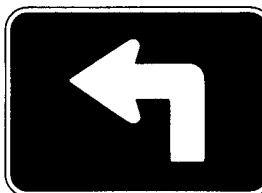
3. The colors of the Advance Bend Arrows shall correspond to the colors of the route markers.



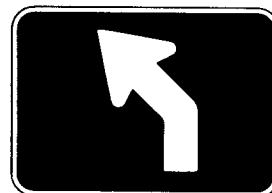
I 3-1R



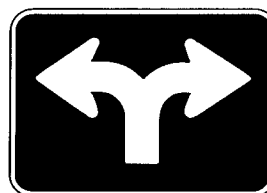
I 3-2R



I 3-1L



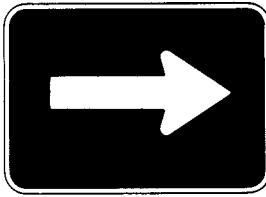
I 3-2L



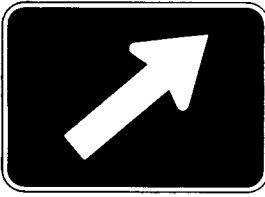
I 3-1LR

#### U. Directional Arrow (I 4)

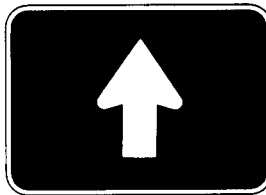
The Directional Arrow marker displays a single-or double-headed arrow, pointing in the general direction that a route may follow. The colors of the Directional Arrows shall correspond to the colors of the route markers.



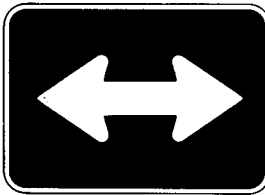
I 4-1R



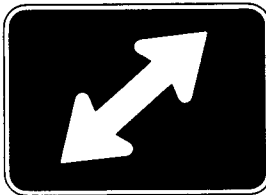
I 4-2R



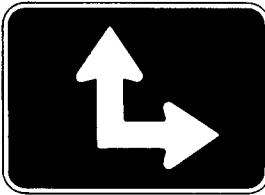
I 4-3



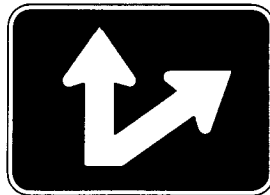
I 4-4



I 4-5R



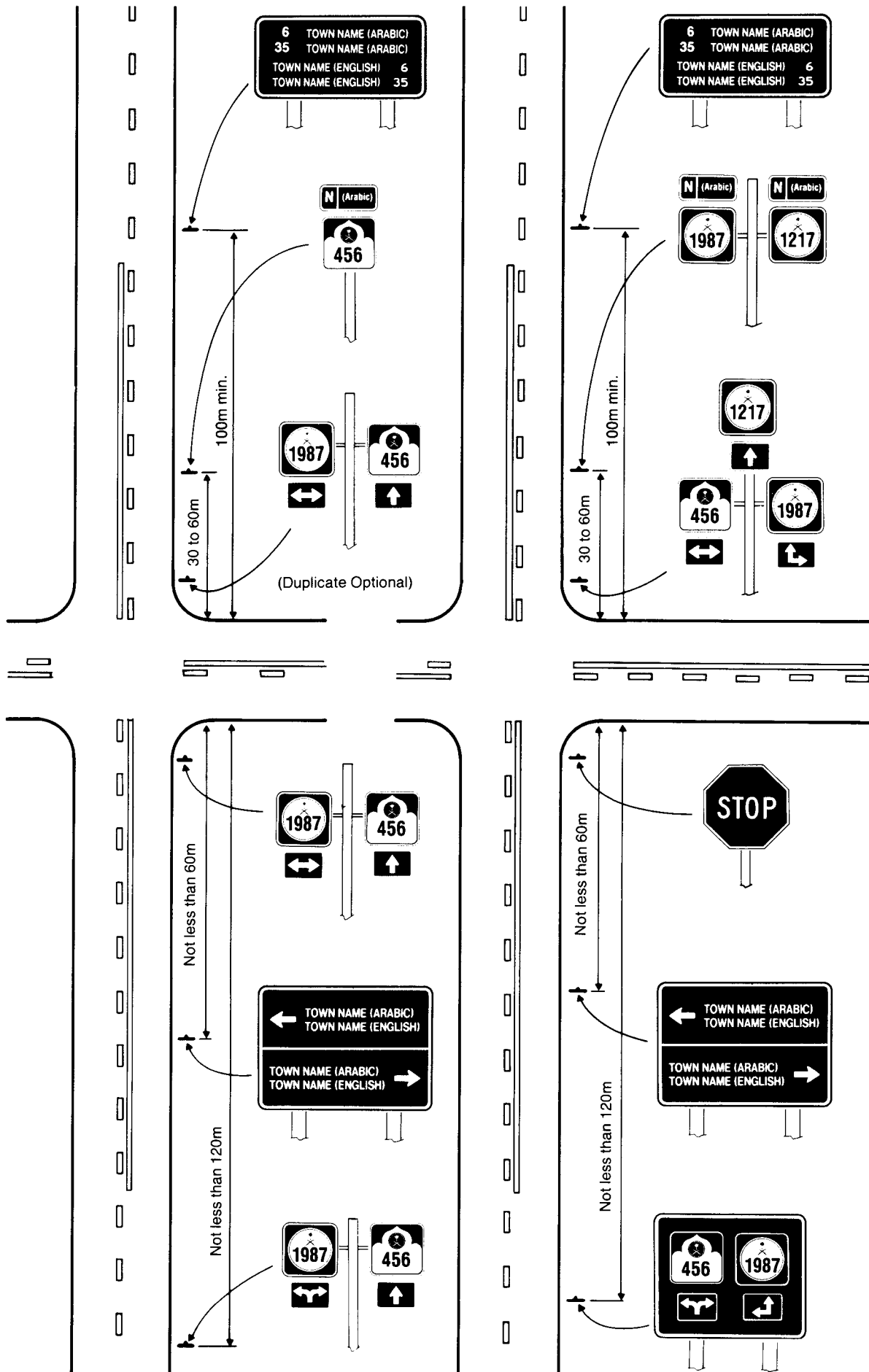
I 4-6R



I 4-7R

#### V. Directional Assembly

Various uses of directional assemblies are illustrated in Figures 2-7, 2-8, and 2-9.



**Figure 2-7**  
**Typical route markings at rural intersections**  
**(for one direction of travel only).**

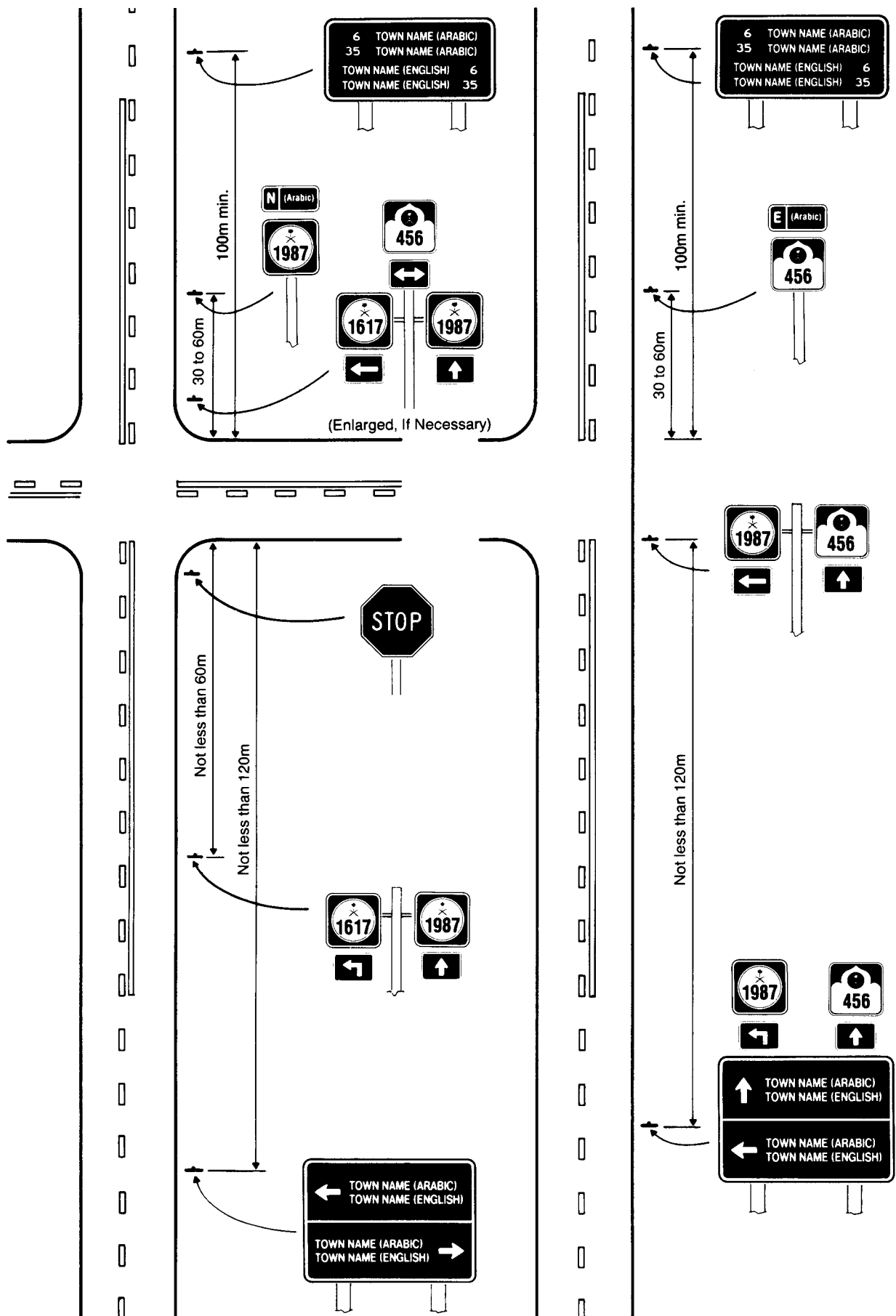


Figure 2-8  
Typical route markings at rural intersections  
(for one direction of travel only).

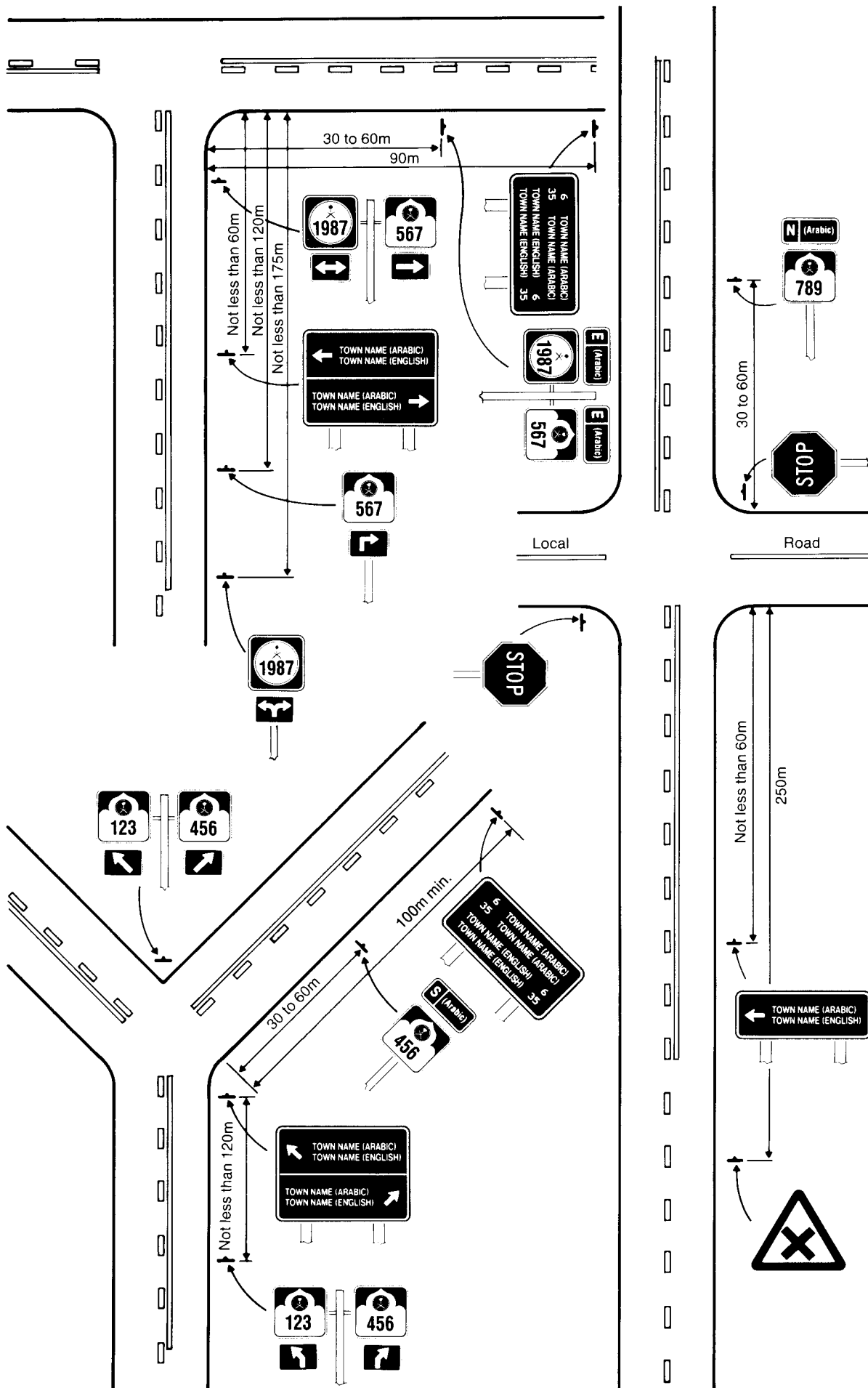


Figure 2-9  
Typical route marking at rural intersections  
(for one direction of travel only).

## **2.05 Informative Signs— Collector and Local Roads**

### **A. Scope of Collector and Local Road Informative Sign Standards**

Standards for Collector and Local Road Informative Signs prescribed shall apply to any highway or street other than an expressway or arterial highway.

### **B. Lettering Style**

The Arabic letter and number style shall be Naskh. All Arabic letters and numbers depicted on the figures throughout this manual are for illustration purposes only. However, when the English letter height exceeds 200 mm, names of places on Informative signs should have an initial upper case letter followed by lower case letters.

### **C. Size of Lettering**

Arabic letters and numbers shall be the largest and have the predominate place on the sign. The English legend shall be smaller than the Arabic, as specified herein.

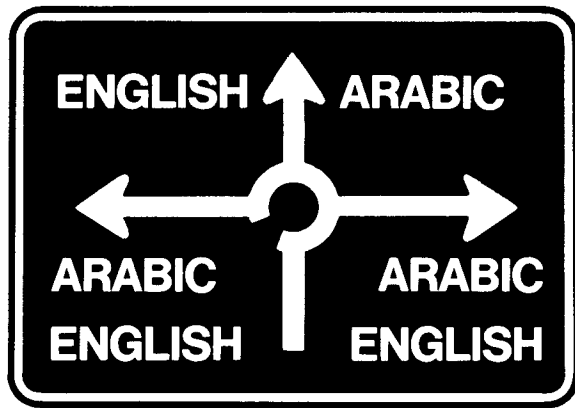
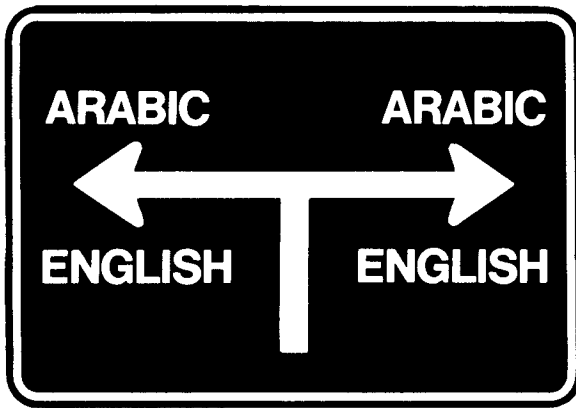
On collector or local roads where volumes are heavier and speeds are higher, the legend shall be in Arabic letters at least 200 mm in height and in English letters at least 175 mm high. On

less important local roads and urban streets where volumes are lighter and speeds are lower the legend shall be in Arabic and English letters at least 150 mm high. Sign panels shall be large enough to accommodate the required legend without crowding.

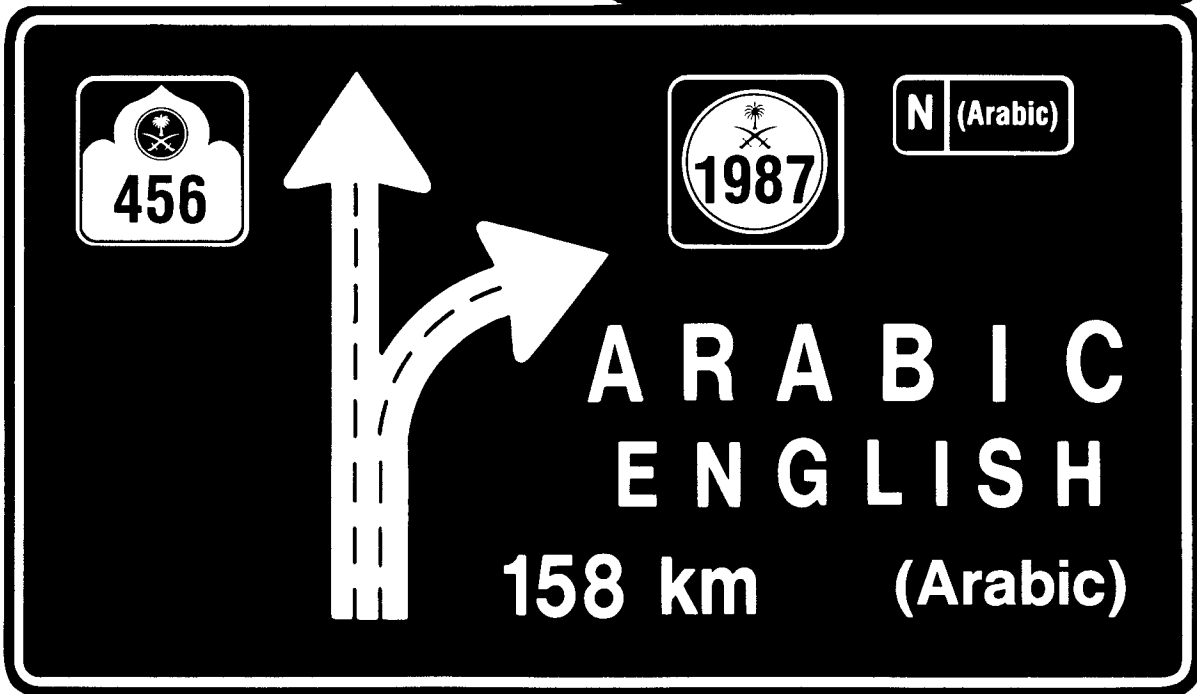
### **D. Advance Direction Signs**

1. Various types of Advance Direction signs are illustrated in Figure 2-10. These are diagrammatic designs and indicate the type of highway geometric configuration which the driver can expect to encounter when approaching the decision point. The Advance Direction signs must be carefully designed to afford the maximum degree of clarity and must be located based on approach speeds.

2. These signs shall be placed a distance from the intersection to be effective for day and night conditions. The location should take into consideration the road and traffic conditions, including the normal speed of vehicles and the distance at which the sign is visible. The distance will be about 150 m on arterial highways and other roads carrying high speed traffic. If necessary, repeat signs can be used with the distance figures being modified to fit.



**EXIT 122 (Arabic)**



**Figure 2-10**  
**Advance direction diagrammatic signs.**  
 See Sec. 2.04 N for background color

## E. Direction Signs

1. Various Direction signs are illustrated below. One direction sign may bear the maximum of three names of destinations. Destination names in each direction shall be grouped together.

2. When distances are shown, the numbers giving the distances shall be the same height as the place name. On rectangular signs, the distances are placed after the place name.

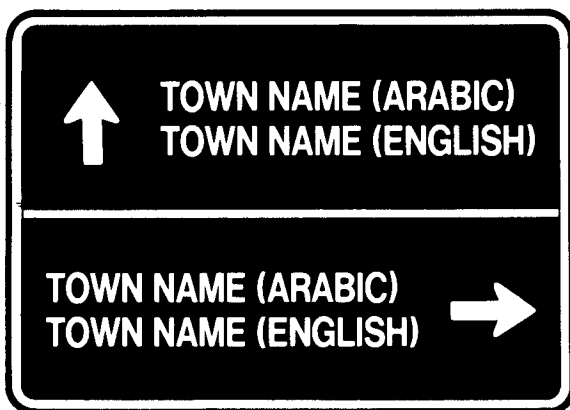
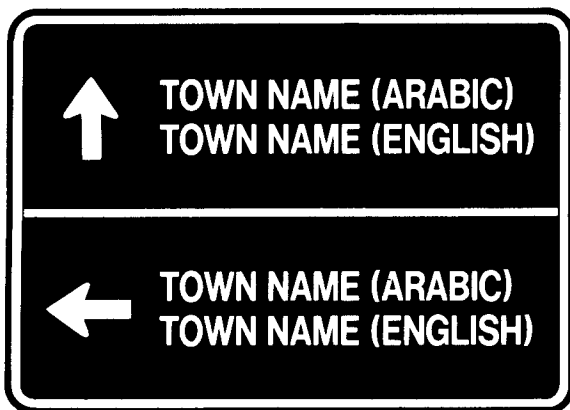
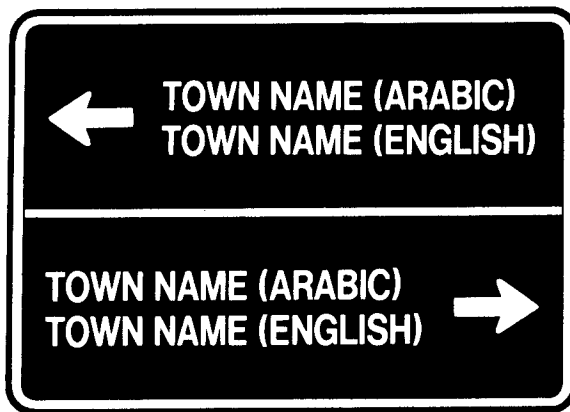
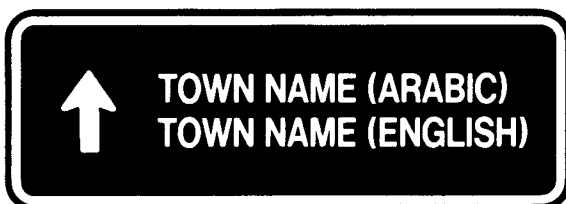
3. A Direction sign gives information either just preceding the decision point to continue through or turn right or left, or at the intersection.

4. Arrows pointing vertically and arrows pointing left shall be at the extreme left and arrows pointing to the right shall be at the extreme right of the sign. For added legibility, it is recommended the width across the barbs of the arrow be at least equal to the height of the largest letters on the sign, and for short downward pointing arrows on overhead signs, about  $1\frac{3}{4}$  times the letter height. (See page 2-34 for detailed information on arrow size.)

5. As a general rule, the directional arrows should be horizontal or vertical, but at an irregular intersection a sloping arrow will

sometimes convey a clearer indication of the direction to be followed.

6. Reading from the top of the sign to the bottom the order for displaying destinations is straight through, left, and right.



See Sec. 2.04N for background color

**Note:** The three signs illustrated above may be combined into one sign.

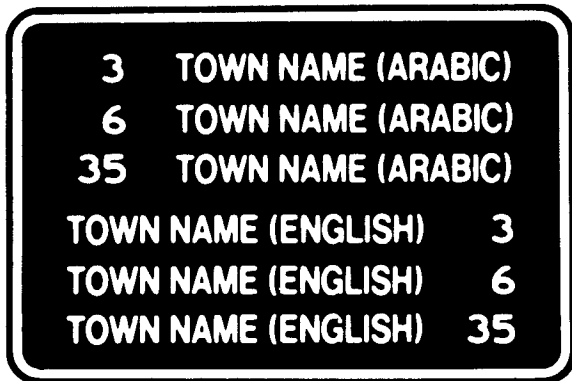
## F. Place Identification Signs

These signs are used to show the frontier between the Kingdom and another country or the boundary between two administrative divisions of the Kingdom. The signs are also used to designate built-up areas, wadis, mountain passes, and historical landmarks.



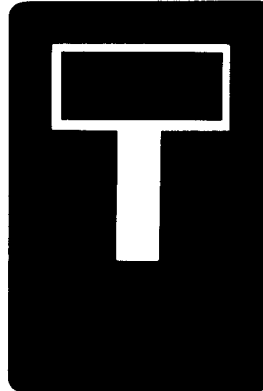
## G. Confirmatory Signs

1. These signs confirm the direction of a road mainly at the exit point from a large built-up area or beyond the intersection with another numbered highway.
2. No more than three places can be identified. Distances also may be shown.

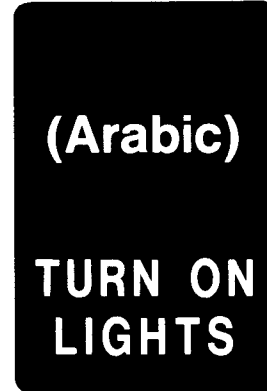


## H. Useful Information Signs

Useful Information signs provide general information which is not included in facilities signing; the parking series; traffic signal operation; and rest, recreational, and cultural areas signing.



No Through Road  
I 6-1  
600x900



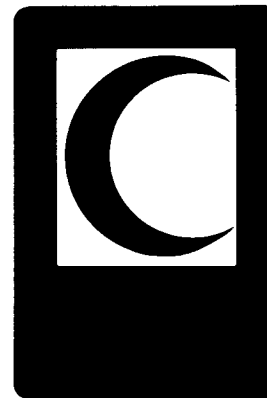
Turn On Lights  
I 7-1  
600x900

## I. Facilities Signs (I 8)

Facilities signs provide information to the traveler on how to find services, both personal and for the vehicle. Service signing covers gas, food, lodging, repairs, first aid, and sickness needs.



Hospital  
I 8-1  
600x900



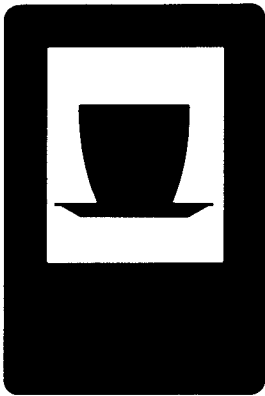
First Aid Station  
I 8-2  
600x900



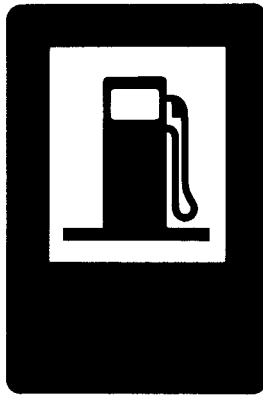
Hotel  
I 8-3  
600x900



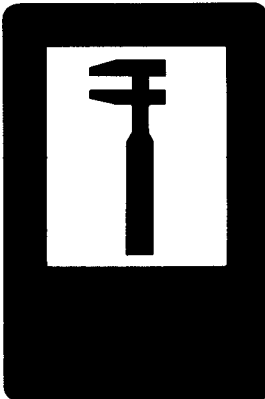
Restaurant  
I 8-4  
600x900



Refreshments  
I 8-5  
600x900



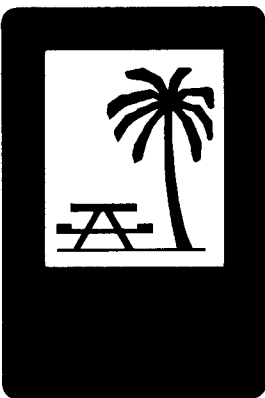
Gas  
I 8-6  
600x900



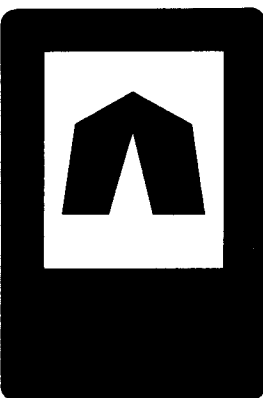
Mechanic  
I 8-7  
600x900



Telephone  
I 8-8  
600x900



Picnic Site  
I 8-9  
600x900



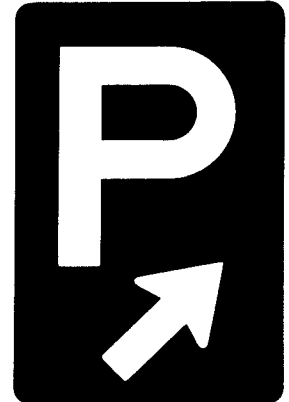
Camping Site  
I 8-10  
600x900

## J. Parking Signs (I 9)

These signs indicate where parking is available:  
on the street, off the street and any parking  
with special instructions.



Parking  
I 9-1  
600x900



Side Parking  
I 9-2  
600x900

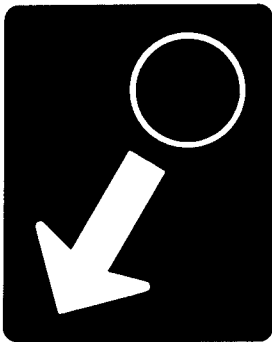


Parking With  
Special Instructions  
I 9-3  
600x900

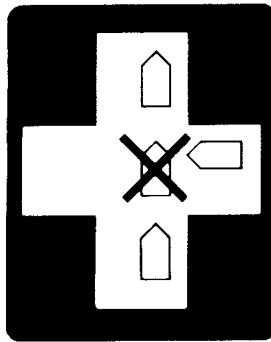
## K. Traffic Signal Signs (I 11)

Traffic Signal signs in this series are often desirable or necessary for instruction of pedestrians and drivers. Traffic Signal signs are used in several situations:

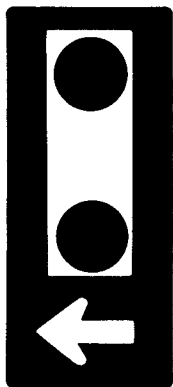
1. Indicate a stopping point. (Figure I 11-1)
2. Guard against blocking an intersection when waiting driver is waiting for a green signal. (Figure I 11-2)
3. Identify certain signals and indicate what the driver must do. (Figure I 11-3)
4. Instruct pedestrians to push button for signals to cross the street. (Figure I 11-4)



Stop Here  
on Red  
I 11-1  
600x750



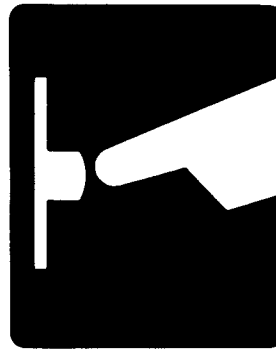
Do Not Block  
Intersection  
I 11-2  
600x750



Left Turn  
Signal  
I 11-3  
600x750



I 11-3A



Push Button for  
Walk Signal  
I 11-4  
225x300

## L. Special Signs for Steep Grades (I 12)

1. This group of signs covers conditions where an escape ramp exists and where no escape ramp exists. Special Informative signs or signs in the Warning series shall be used to fit the conditions as outlined.

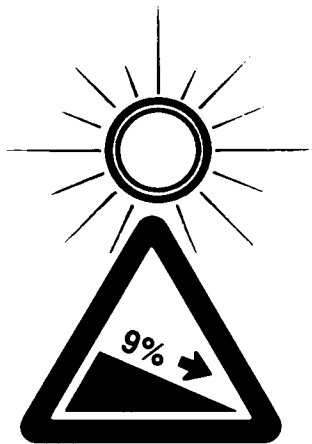
2. Runaway truck ramps are desirable for the safe deceleration and stopping of runaway vehicles on long, steep downgrades where installation is practical.

3. The Advance Warning signs to be used on the runaway truck ramps are to be located in advance of the gore area and at the entrance onto the escape ramp. The advance signing could begin at the summit in conjunction with a brake check turnoff or pullout area, if provided. As a minimum the advance signs should begin at 2 km in advance of the exit, a repeat sign at 1 km, and then, the exit direction sign at the gore.

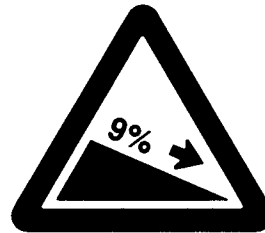
4. Regulatory signs are to be placed in the general area of the exit to the ramp to keep vehicle drivers from using the escape area for parking. Signs containing the message or symbol, Runaway Vehicles Only and/or No Parking Any Time; and No Stopping Any Time, are to be used to prohibit attempted misuse of the ramp area.

5. The Informative sign that shall be used is a diagrammatic sign, which is designed for truckers. This large sign would be erected at a turnoff or pullout area at the summit so that the truck driver could study the alignment and would also be advised, in Arabic, of the percentage of descending grade, the length of the descent, and the emphasis of the need to gear down.

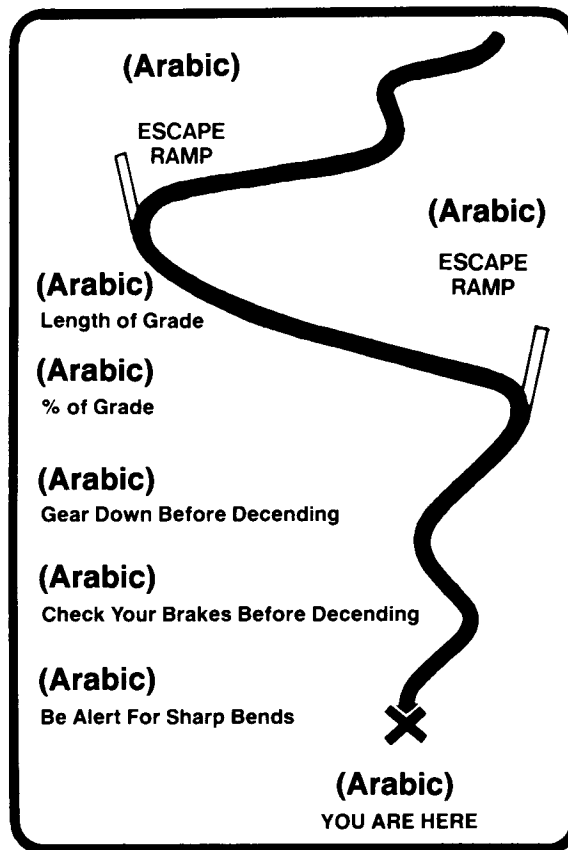
6. Examples of typical sequence signing where an escape ramp exists are as follows (W 2):



Descent  
W 2-2  
1100x1100



Descent  
W 2-1  
1100x1100



## M. Other Symbols

Other symbols as can be used are:



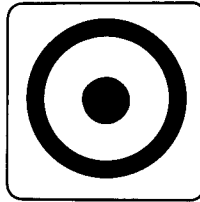
**Airport (I 12-1)**

This symbol gives information of the direction to an airport.

Normally the symbol is used without the name of the airport, but if there is more than one airport in the area, the names may be used in combination with the symbols.

The symbol shall be turned with the nose of the plane pointing at the direction to follow in order to reach the airport.

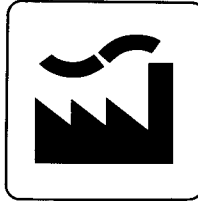
The color of the symbol shall be black on white background.



**City Center (I 12-2)**

This symbol gives information of the direction to a City Center.

The symbol is black on white background and in combination with the text "City Center".



**Industrial Area (I 12-3)**

This symbol gives information of the direction to an Industrial Area.

The symbol is black on a white background and shall be in combination with the name of the industrial area or with the word Industrial Area.

## **2.06 Informative Signs—Expressways and Arterial Highways**

### **A. Scope of Standards for Informative Signs on Expressways and Arterial Highways**

1. Since many geometric design variables are found in existing expressways and arterial highways, a signing concept commensurate with prevailing conditions must be the prime consideration. Whenever possible, expressway and arterial highway signing should be planned at the design stage.
2. Standards for Informative signs prescribed shall apply to any expressway or arterial highway as applicable, unless specifically excepted elsewhere. These standards provide a uniform and effective system of highway signing which is adequate for high-volume, high-speed motor vehicle traffic on all modern expressways and arterial highways.

### **B. General Characteristics of Signing**

1. Expressway and arterial highway signing should always be considered and developed as a planned system of installations. Engineering study will be necessary for the proper solution of the problems of many individual locations. In addition, consideration of an entire route is necessary.
2. Drivers should be presented with consistent signing on the approaches to interchanges.
3. The standards prescribed for sign letter size are the same for both urban and rural areas. Space is often at a premium on urban sections, but the typical traffic pattern is also more complex for the driver to negotiate, and large easy-to-read lettering is just as necessary as on rural highways. The use of two languages on each panel on the sign board requires that destinations shall appear in Arabic on the top line and in English on the bottom line. This will require larger sign boards to achieve this desirable easy-to-read letter size.

### **C. Size of Lettering and Legend Spacing**

1. The prescribed numeral and letter sizes according to highway classification and component of sign legend appear in the Appendix.
2. All names of places, streets, and highways on expressway and arterial highways' Informative signs shall be composed of Arabic style letter and number, as designated by the Ministry of Communications. On signs with dual language messages, the letter size of the English legend shall be approximately two-thirds of the Arabic letter size. The Ara-

bic letter sizes will be determined first and the English sizes will be adapted to the Arabic sizes.

### **D. Arrows for Interchange Informative Signs**

1. On exit direction signs (overhead or ground mounted), arrows to indicate a movement ahead or slightly right or left shall be upward slanting and located on the appropriate side of the sign.
2. Downward-pointing arrows are lane assignment arrows and shall be used only on overhead guide signs to prescribe the use of specific lanes for traffic bound for a destination or route that can be reached only by being in the lane(s) designated. A separate arrow should be centered over each lane for the signed destination or route.

### **E. Interchange Classification**

For expressway and arterial highway signing purposes, interchanges are classified as major and minor.

1. Major interchanges are subdivided into two categories:
  - a. Interchanges with other expressway or arterial highways.
  - b. Interchanges, other than those named in (a), with high-volume, multi-lane highways; and major rural routes where the traffic is heavy or includes many drivers unfamiliar with the area.
2. Minor interchanges include those where traffic is local and light, such as the interchanges with land service access roads.

### **F. Designation of Destinations**

1. "Control" destination points along the route must always be selected and then shown on the signs as the next major destination point. Destination legends should provide the drivers the best orientation possible. Continuity in successive sign messages and consistency with available map information is essential.
2. Selecting major destinations along the expressway or arterial route is important to the quality of service provided by these routes. Control destinations should be used in advance of the following:
  - a. Interchanges between expressway and arterial routes.
  - b. Separation points of overlapping expressway or arterial highway routes.
  - c. On intersecting routes to guide traffic

entering the expressway or arterial highway route.

d. On "Pull Thru" signs (for a destination beyond an intersection or interchange).

e. On the bottom line of post interchange distance signs.

3. Post-interchange distance signs may be installed when additional information is needed beyond the interchange. These signs shall consist of two- or three-line messages carrying the names of significant destinations and distances to those points.

#### **G. Routing to a Given Destination**

A route diverging from an expressway or arterial highway route should not have any of the same destination names which are shown at that point for the expressway or arterial highway route. At any decision point, a given destination shall be indicated on or via only one route.

#### **H. Overhead Sign Installations**

1. Overhead signs have an application in lieu of or as an adjunct to ground signs (See Section 2.01).

2. Overcrossing structures can often serve for the support of overhead signs and may be the only practical location providing adequate viewing distance.

3. Overhead signs shall have a vertical clearance of not less than 5.5 m to the sign, light fixture, or sign bridge over the entire width of the pavement and shoulders.

4. Overhead sign installations shall be illuminated where possible, especially on highways with roadway lighting or high traffic volume. On expressways and arterial highways, all overhead signs not independently illuminated shall be reflectorized. In some instances the highway may be too remote from a power source to permit illumination. The illumination chosen should provide effective and reasonably uniform illumination of the sign face and message. Solar powered lighting might be used at remote locations. Where internal illumination is used, the sign colors shall appear essentially the same by night and day. When a sign is internally illuminated, the requirements for reflectivity do not apply.

5. Overhead reflectorized panels may contain either white reflective cutout letters and numerals placed on a blue reflectorized background or white embossed letters and numerals with white reflex reflectors on an opaque blue background.

#### **I. Number of Signs at an Overhead Installation**

1. When overhead signs are warranted, it is desirable to limit the number of signs at these locations to only those essential in communicating pertinent destination information to the motorist. Exit Direction signs for a single exit and the Advance Direction Informative signs will only need one panel with one or two destinations. The distance between successive signs should be considerably greater than the minimum where feasible allowing enough time for motorists to easily read them.

2. At other overhead locations it may be necessary to erect more than one sign to inform motorists of a multiple exit condition at an interchange. Where complex geometrics occur, it may be necessary to provide additional panels with confirmatory messages to guide the motorist properly. In no case should more than three signs or panels be displayed at any one location.

#### **J. Signs for Intersections at Grade**

Whenever there are intersections at grade within the limits of a minor highway, signs should be of a size compatible with the design of other signing on the arterial highway. Advance Direction Informative signs for intersections at grade may take the form of diagrammatic layouts depicting the geometrics of the intersection along with essential directional information.

#### **K. Interchange Numbering**

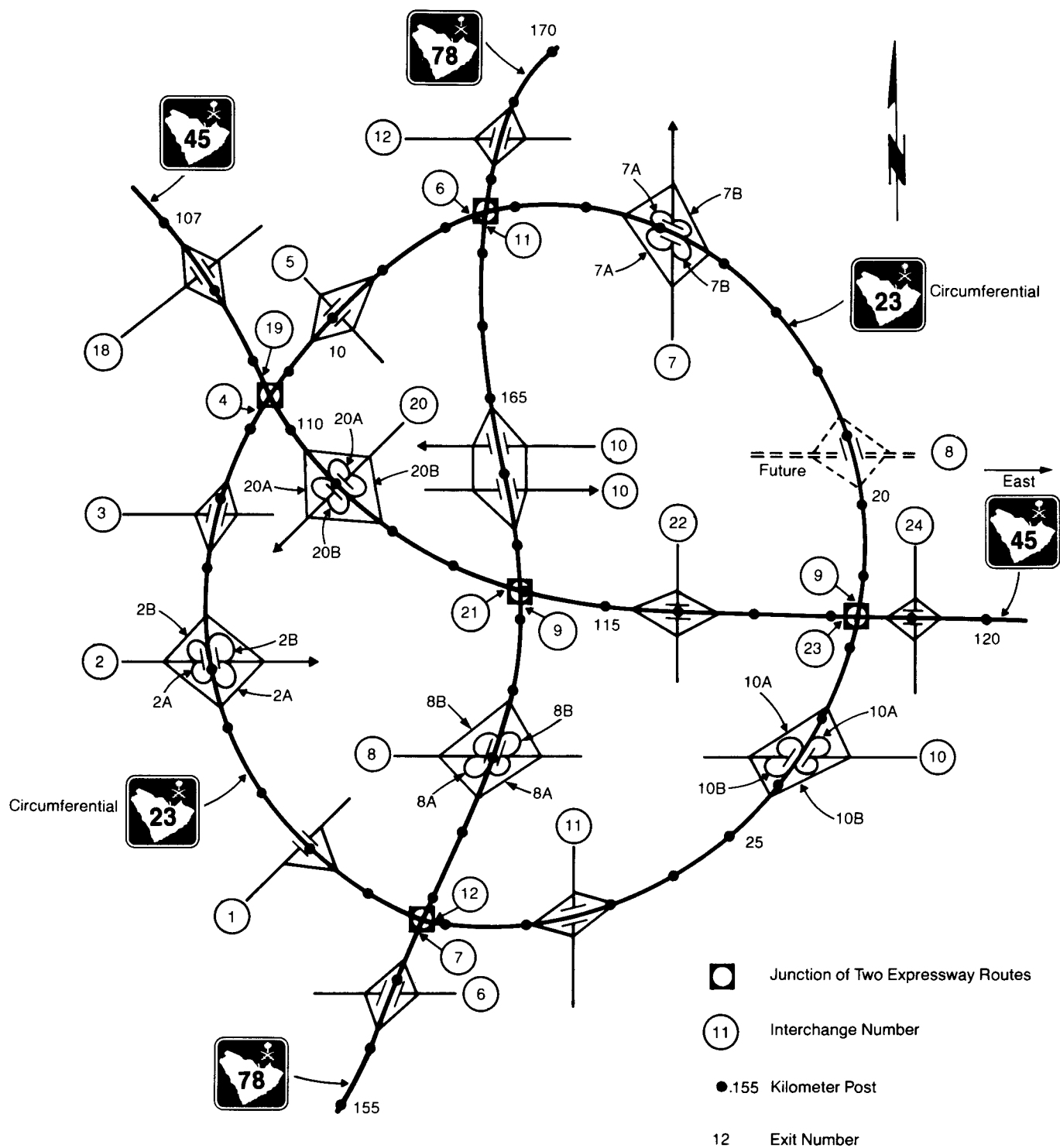
1. Interchange exit numbering along expressways or arterials provide valuable orientation for the driver and shall be used in signing each interchange exit. The general plan for numbering interchange exits is shown in Figs. 2-11 through 2-13.

2. Interchange exit numbers shall be shown with each Advance Direction Informative sign, the Exit Direction sign and the Gore sign. They may be used with supplemental Informative signs. The exit number is to be displayed on a separate panel at the top of the major sign.

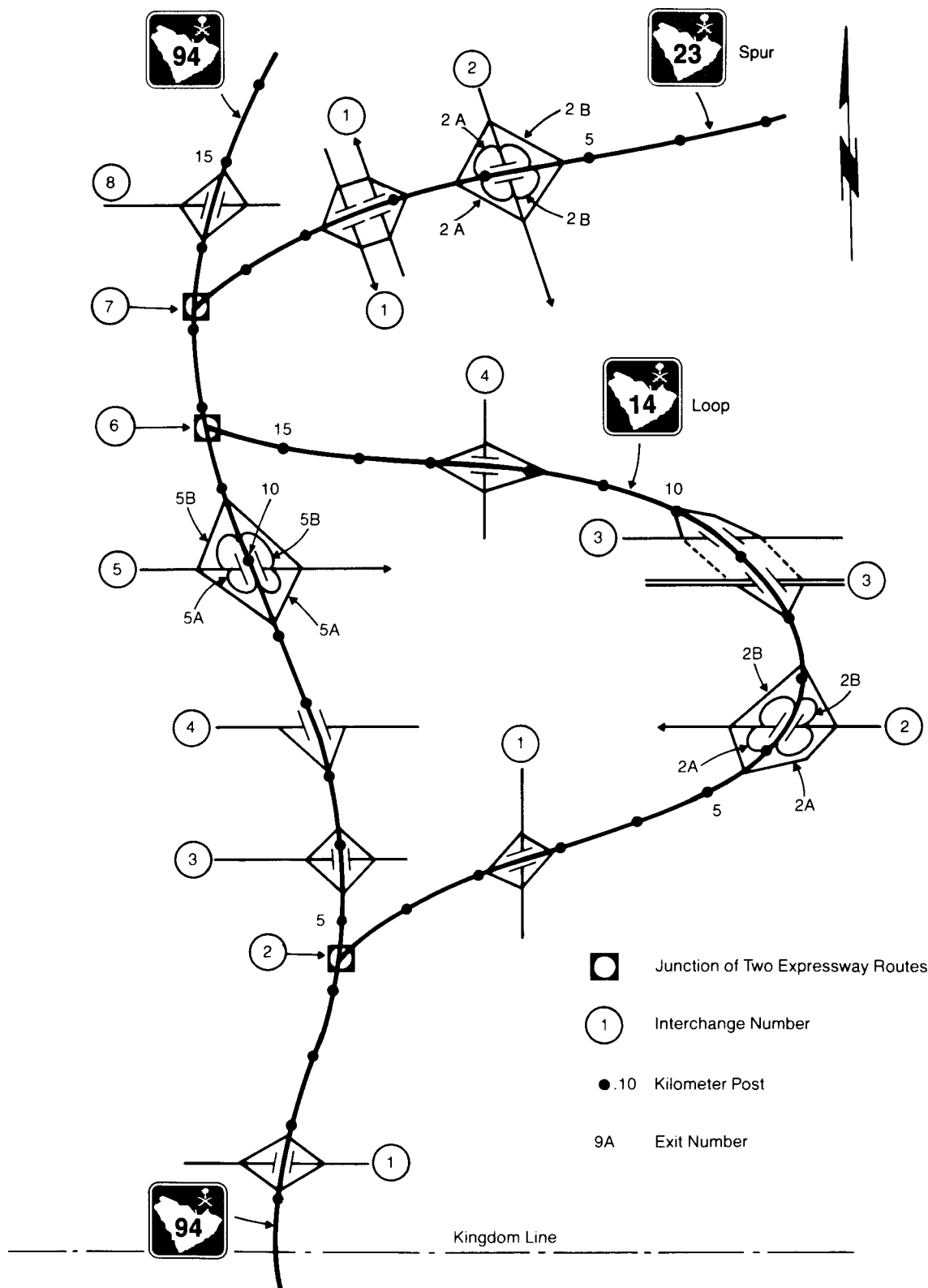
3. Where numbered expressway or arterial routes overlap, continuity of interchange numbering shall be established for only one of the routes.

4. The exit number legend shall be white letters and numerals on a blue background.

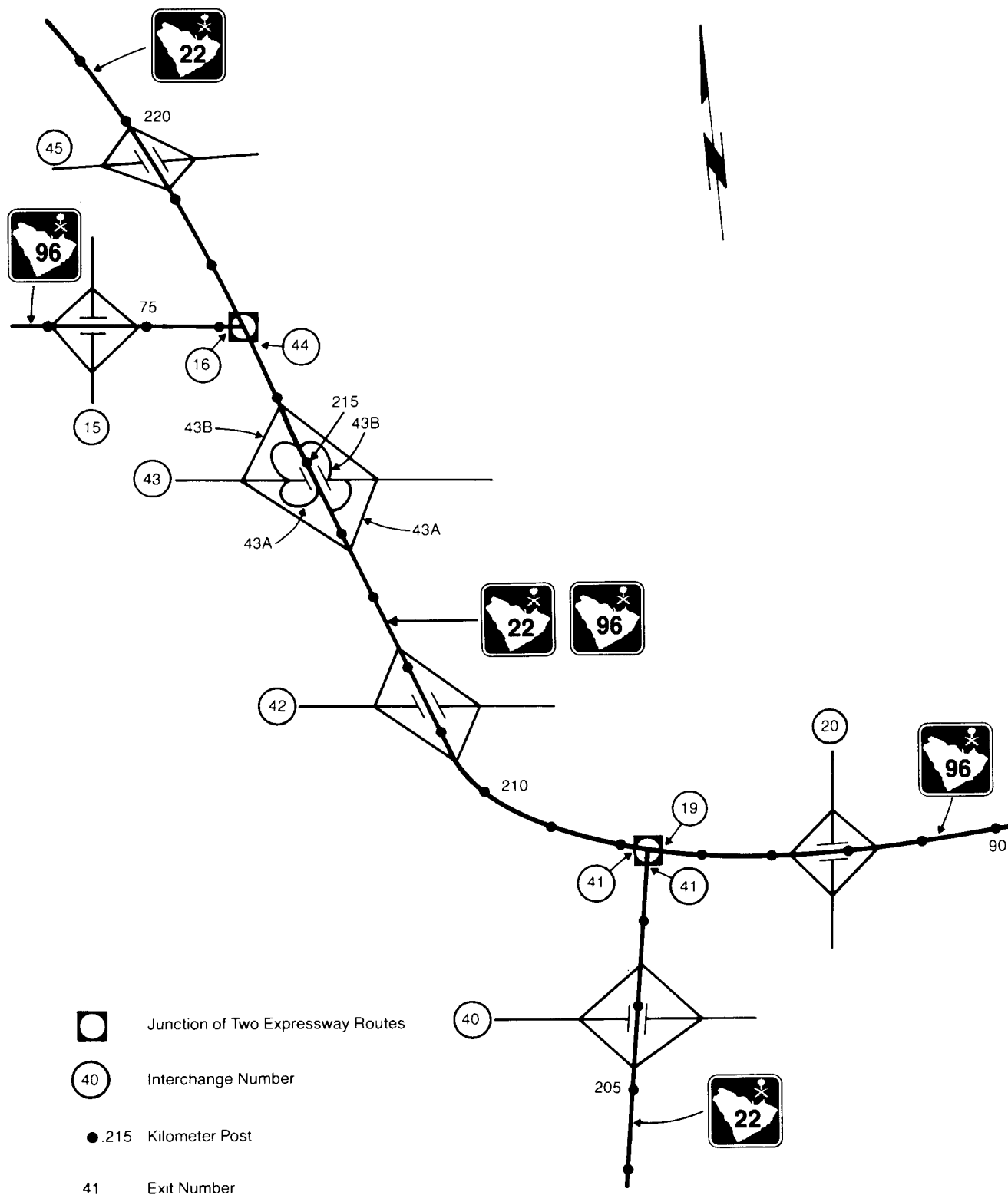
**EXIT 122 (Arabic)**



**Figure 2-11**  
**Typical interchange numbering for mainline and ring routes.**



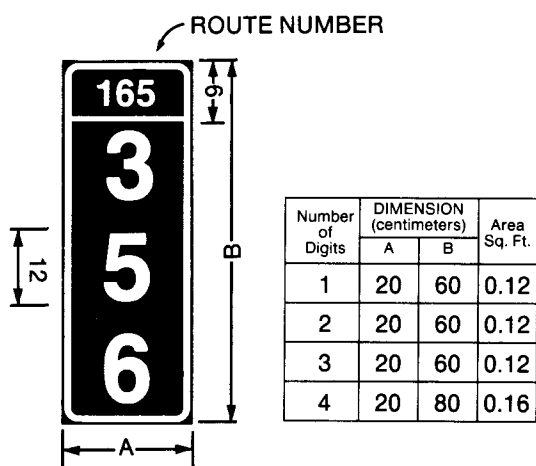
**Figure 2-12**  
**Typical interchange numbering for mainline loop and spur routes.**



**Figure 2-13**  
**Typical interchange numbering where expressway routes overlap.**

## L. Kilometer Posting

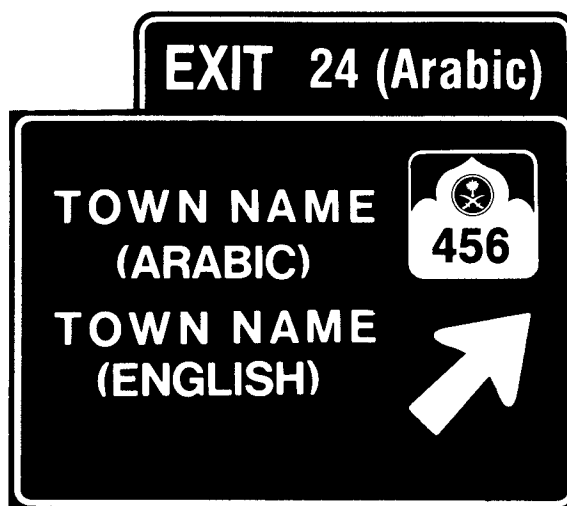
1. Kilometer signs will be installed on all classes of highways. Numbering will run from west to east and from south to north.
2. Kilometer posting also will be used on ring roads.
3. Kilometer posts shall be placed at exact kilometer stations measured along the center line.
4. On two-lane roads, a kilometer post shall be placed along the right shoulder only but with ascending-descending kilometers on either side, whichever is appropriate.
5. On multi-lane highways, a kilometer post shall be placed along both outside shoulders but with ascending or descending kilometers, whichever is appropriate.
6. The panels shall be located in line with the delineator posts.



**KILOMETER MARKERS**

## M. Interchange Informative Signs

1. Interchange Informative signs, in proper sequence, give all necessary route and destination information through interchanges (Fig. 2-24 through Fig. 2-35). New destination information should not be introduced into the major sign sequence for an interchange nor should information be dropped.
2. Informative signs placed in advance of an interchange deceleration lane should be spaced at least 250 m apart. This minimum spacing can be reduced, where necessary, to 200 m if operating speeds are 65 km/h or less.



**Figure 2-14**  
Interchange informative signs.

#### N. Advance Direction Signs

1. The Advance Direction sign gives notice well in advance of the exit point of the principal destinations served by the next interchange and the distance to that interchange. Where there is less than 2 km between interchanges, interchange sequence series signs should be used in lieu of the Advance Direction sign for the affected interchanges. (See Figure 2-14).

2. For major interchanges, two Advance Direction signs shall be used. The recommended location for their placement is approximately 1 km and 2 km from the theoretical gore. Use of these signs is shown in Figure 2-24.

For minor interchanges, one Advance Direction sign shall be used. The recommended location for placement is approximately 1 km from the theoretical gore. With both the major and minor types, a shifting of advance distances may be necessary to fit a specific condition.



Figure 2-15  
Supplemental direction sign.

3. Supplemental direction signs (Figure 2-15) may be erected between major Advance Direction signs. These signs would show destinations, accessible from an interchange, which are not shown on the standard sequence signing. The Interchange number should be listed on each sign. (See Figure 2-24). Supplemental signing can reduce the effectiveness of other more important informative signing because of the possibility of overloading the driver's capacity to obtain and retain information transmitted.

#### O. Exit Direction Signs

1. The Exit Direction sign repeats the route and destination information which was shown on the Advance Informative sign(s) for the next exit.

2. Exit Direction signs shall be used at all interchanges.

3. The sign shall carry the exit number, route number, cardinal direction and destination with an appropriate upward slanting arrow.

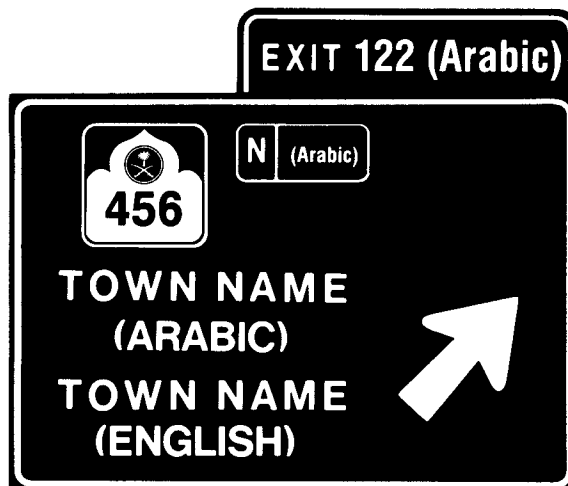


Figure 2-16  
Exit direction sign.

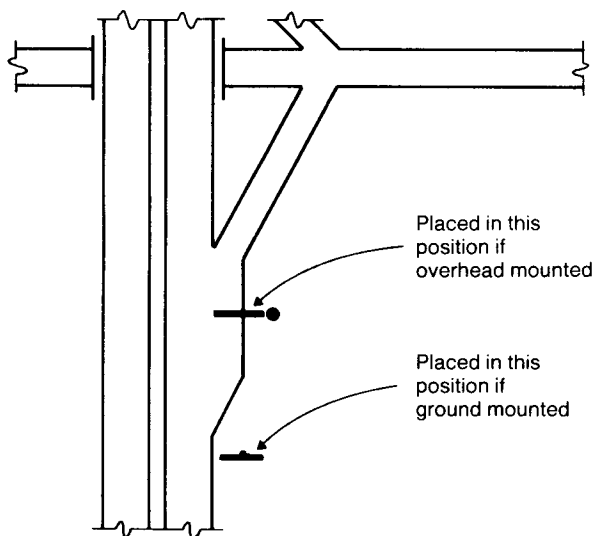


Figure 2-17  
Placement of exit direction sign.

#### P. Gore Signs

1. The Gore sign indicates the place of departure from the main-line roadway. There shall be consistent application of this type of sign.

2. The Gore sign shall be located in the area between the main roadway and the ramp at all exits.

3. The sign shall carry the word EXIT with an interchange number and an appropriate upward slanting arrow, which is aligned to approximate the angle of departure.



Figure 2-18  
Gore sign.

#### Q. Exit Only Panel

1. Major Informative signs for all lane drops (where the lane exits rather than continuing beyond the exit) at interchanges shall be mounted overhead. The Exit Only panel(s)

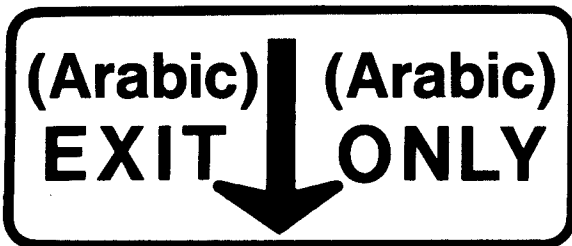
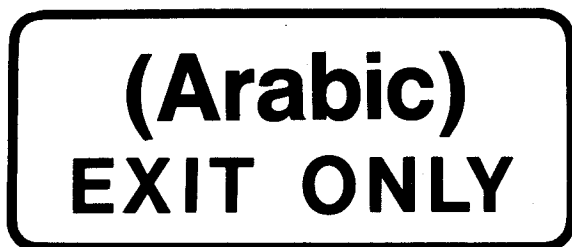


Figure 2-19  
EXIT ONLY panels.

shall be used on the Advance Direction signs and the Exit Direction signs for all interchange lane drops at which the through route continues ahead on the main-line. Advance Informative signs further than 1 km from the interchange shall contain the distance message. Advance Informative signs for lane drops within 1 km of the interchange shall not contain the distance message. Exit Only panels shall have black legend on a yellow reflectorized background.

2. Wherever the through route exits on a lane which does not continue on the main-line, diagrammatic signs should be used without the Exit Only panel.

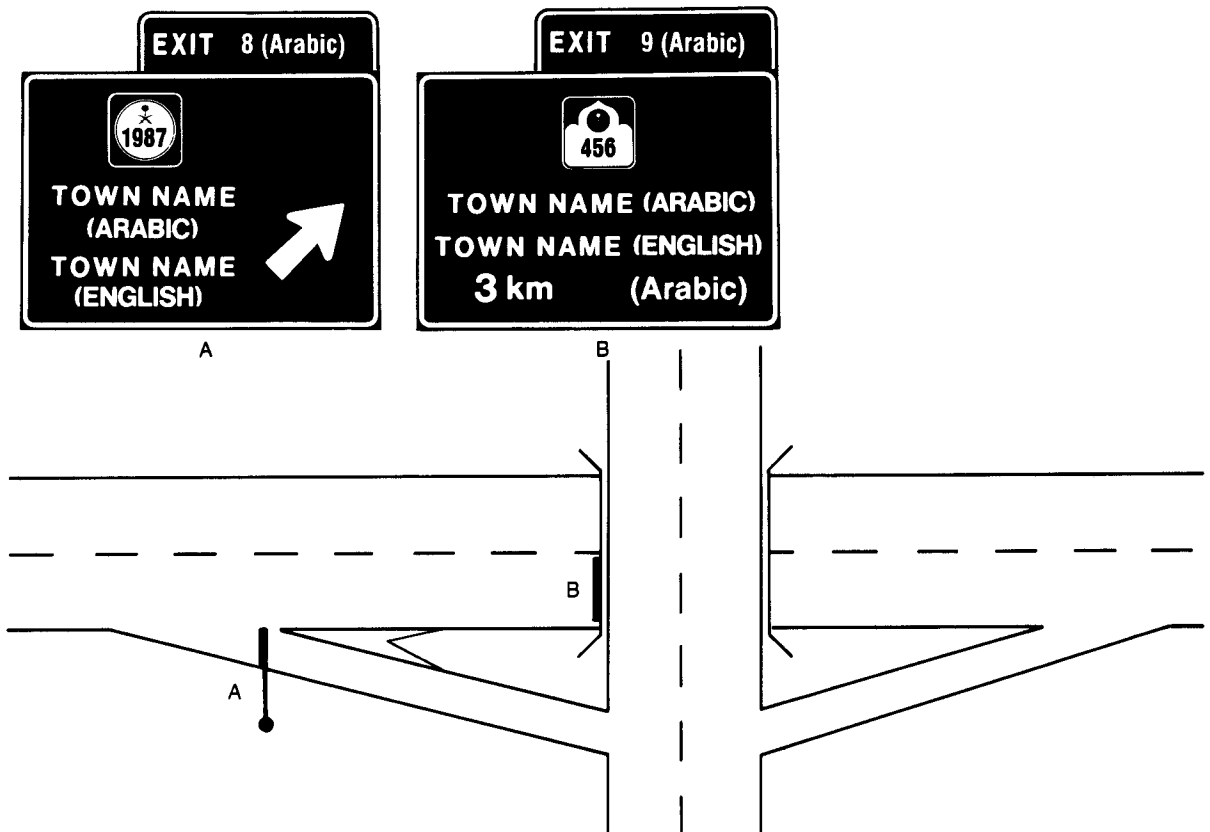
#### R. Sign Spreading and Pull Thru Signs

1. Sign spreading is a concept in which major overhead Informative signs are so spaced that the ability of motorists to comprehend the information is not overloaded by having too many signs at one location. Where overhead signing is used, sign spreading should be used at all single exit interchanges and to the extent possible at multi-exit interchanges.

2. Sign spreading is accomplished as follows:

a. The Exit Direction sign is the only overhead sign used in the vicinity of the gore. It is located over the roadway near the theoretical gore and may be on a sign bridge or cantilever structure over the exiting lane.

b. The Advance Informative sign for the next interchange exit should be placed on the interchange overcrossing structure when the crossroad goes over the main-line. If the main-line goes over the crossroad, the sign should be placed on a cantilever over the lane or it may be ground mounted behind the guardrail leading to the bridge rail.



**Figure 2-20**  
**Spreading of informative sign information.**

## S. Diagrammatic Signs

1. The use of diagrammatic signs in advance of intersections and interchanges have been shown to be superior to conventional signs for some applications. These signs are Informative signs which show a graphic view of the exit arrangement in relationship to the main highway. Diagrammatic signs should be used for several situations:

- Advance guide sign location for left exits and for some interchanges between expressways.
- Splits having off-route movements to the left.
- Optional lane splits.
- Exits with route discontinuity.
- With left exit lane drops.
- Two-lane exits with an optional lane.
- Diagrammatic signs shall not be used at cloverleaf interchanges. Conventional signing is superior in this instance.

2. Diagrammatic signs shall be designed in accordance with the following criteria:

- The graphic legend shall be of a plan view showing a simplified off-ramp arrangement.
- Only one destination may be shown for each arrowhead, with a maximum of two destinations per sign.
- The shaft for the exit ramp movement should be shorter than but not separated from the through movement graphic.
- Arrow shafts should contain lane lines where appropriate.
- Destinations, in Arabic and English, should be clearly related to the arrowhead.
- A cardinal direction plaque may be used if desirable. It should generally be placed adjacent to the destination.

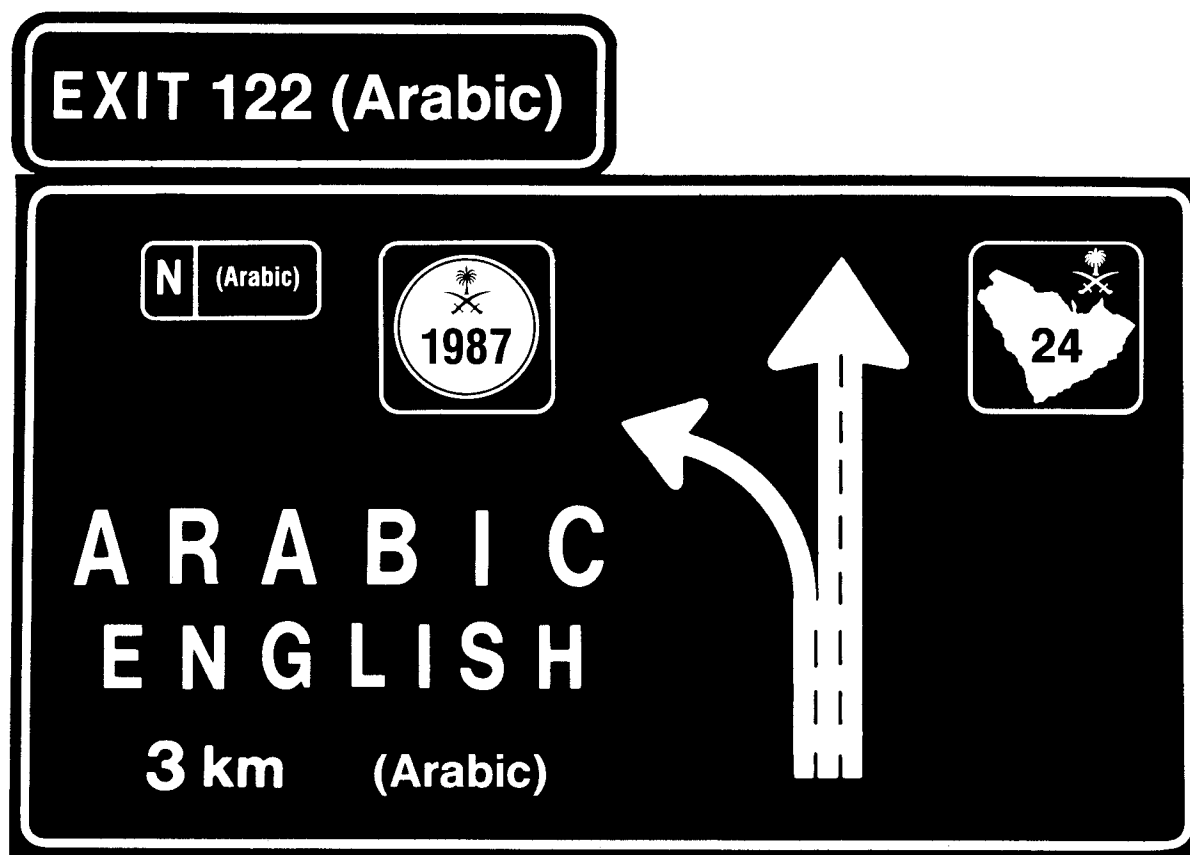


Figure 2-21  
Diagrammatic sign.

## T. Rest Areas Signs

1. On the approach to rest areas, an Advance Direction sign shall be placed 2 km or 3 km in advance of the rest area. Between the advance Informative sign and the gore of the rest area exit, there may be a sign reading REST AREA, which shall carry either an arrow or the words NEXT RIGHT as part of the message.
2. At the rest area exit gore, there shall be a sign with a message REST AREA together with an arrow indicating the proper turn.
3. The word messages are to be in Arabic and English with the Arabic appearing on the top.

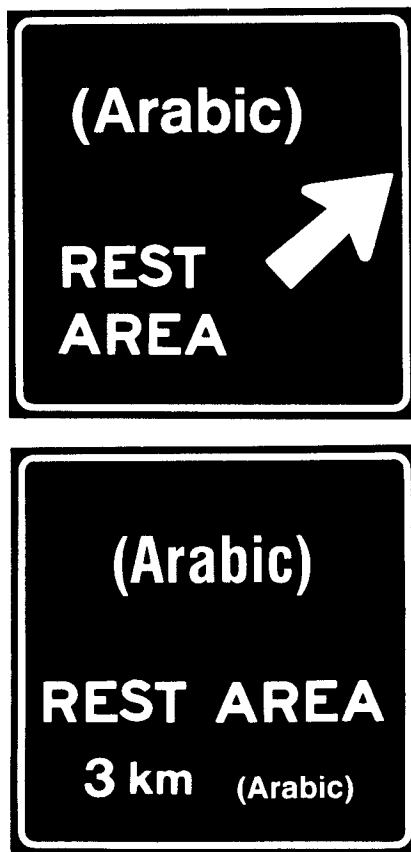


Figure 2-22  
Expressway rest area signs.

## U. Recreational and Cultural Interest Area Signs

An example of signing for Recreational and Cultural Interest Areas is as follows:

1. Recreational and cultural interests are attractions or traffic generators, some of which are open to the general public for various purposes. Recreation areas are provided to refresh the body or mind. Cultural areas are provided for the training and refining of the mind and emotions.

2. Where recreational or cultural interest areas are a significant destination on a numbered highway route, special signs shall be posted for such areas. This shall be done where the access road to the interest area intersects the highway. The shape of the signs shall be rectangular, and the colors shall be white message on a brown background. The name of the area shall be in Arabic and English.
3. If the interest area is a major traffic generator, then it will be necessary to install an advance sign some distance ahead of the actual turnoff point. This sign will alert drivers to determine if they want to visit the interest area.

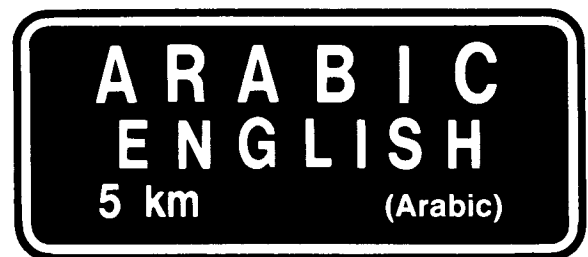


Figure 2-23  
Recreational and cultural interest area sign.

## V. Typical Interchange Signing Applications

In the following figures, typical sign installations are illustrated. The caption under each illustration describes the signing function as follows:

1. Typical advance signing for single-exit major interchanges (Fig. 2-24).
2. Minor interchange (Fig. 2-25).
3. Diamond interchange (Fig. 2-26).
4. Urban diamond interchange (Fig. 2-27).
5. Partial cloverleaf interchange (Fig. 2-28).
6. Cloverleaf interchange (Fig. 2-29).
7. Series of closely spaced interchanges using sequence signs and sign spreading (Fig. 2-30).
8. Optional lane split (NO overlapping routes), (Fig. 2-31).
9. EXIT ONLY on right (right-hand interchange lane drop), (Fig. 2-32).
10. EXIT ONLY on left with diagrammatic (left-hand interchange lane drop), (Fig. 2-33).
11. Two-lane exit with optional lane (Fig. 2-34).
12. Two-lane exit with optional lane and route discontinuity (Fig. 2-35).
13. Split without optional lane having off route to left (Fig. 2-36).
14. Typical direction signs (Fig. 2-37 and Fig. 2-38).

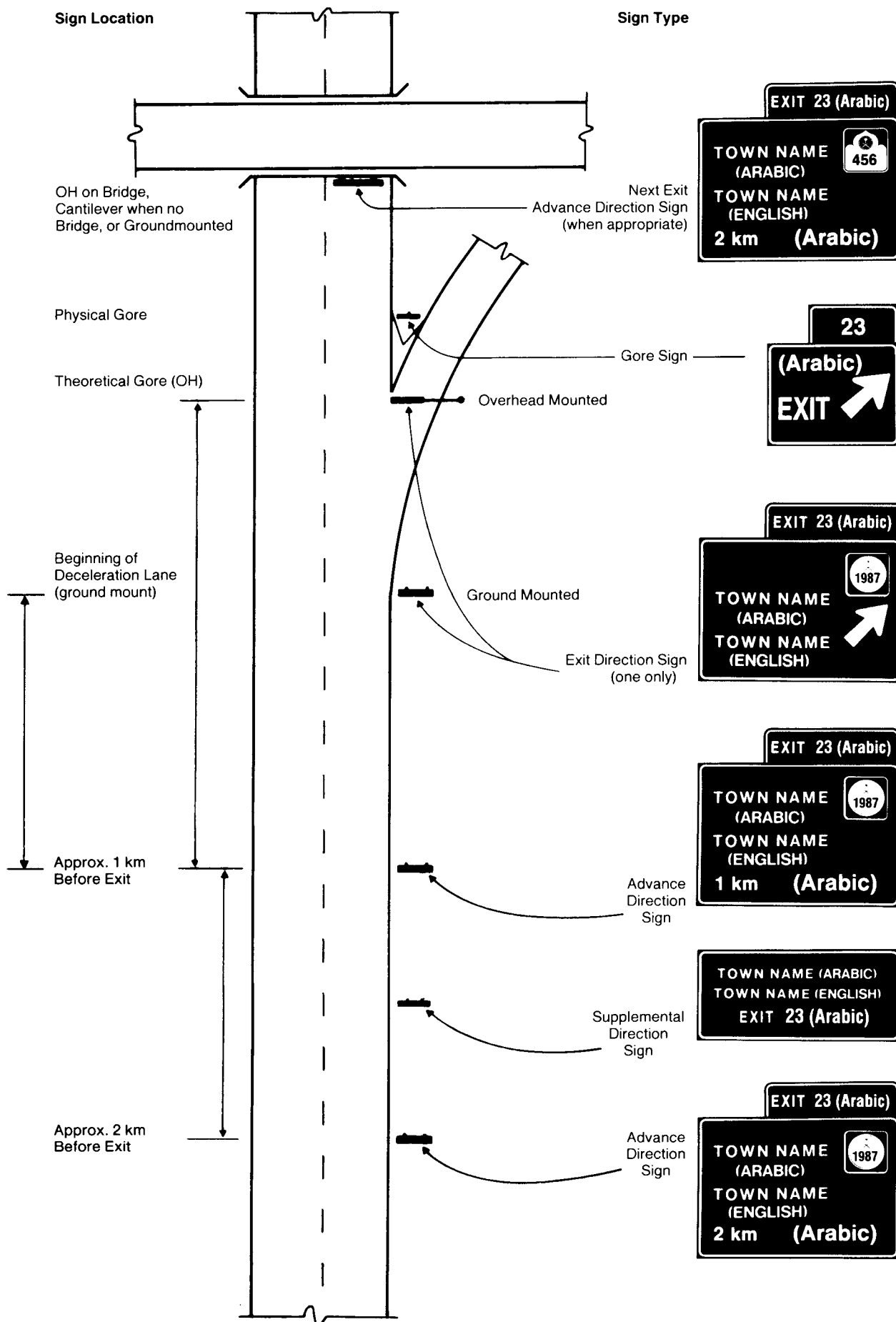


Figure 2-24  
Typical advance signing for single-exit major interchange.

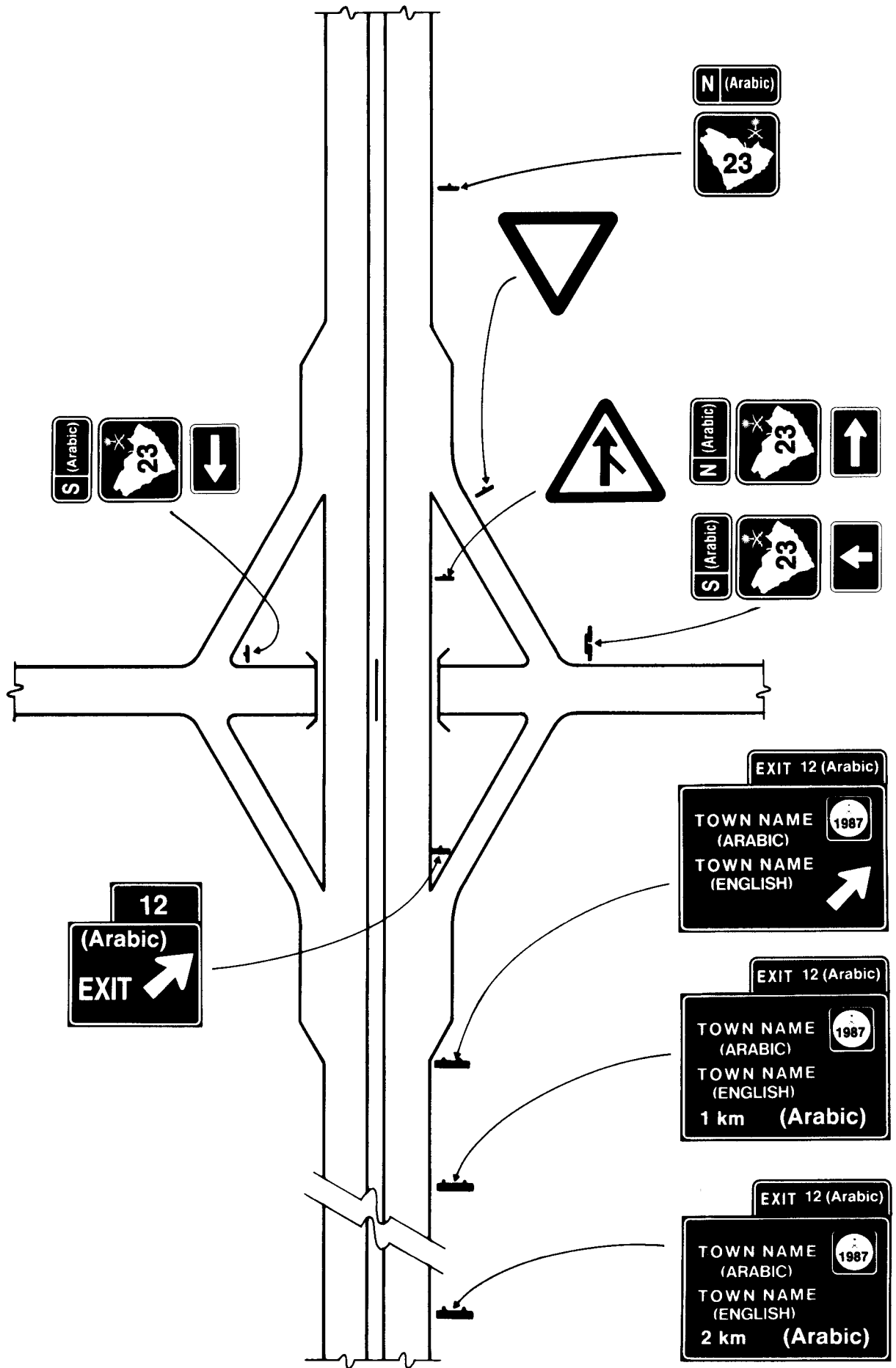


Figure 2-25  
Minor interchange.



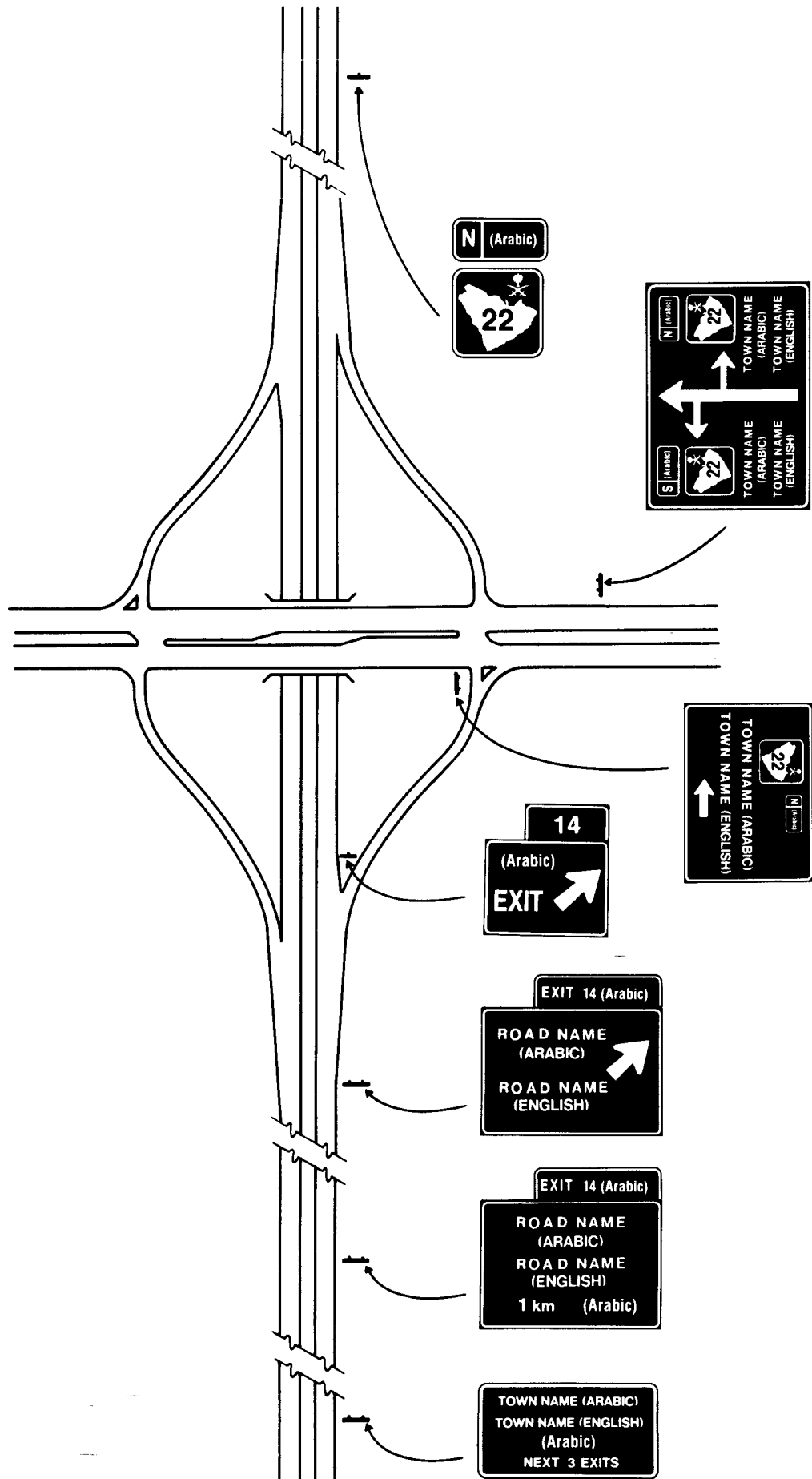


Figure 2-27  
Diamond interchange.

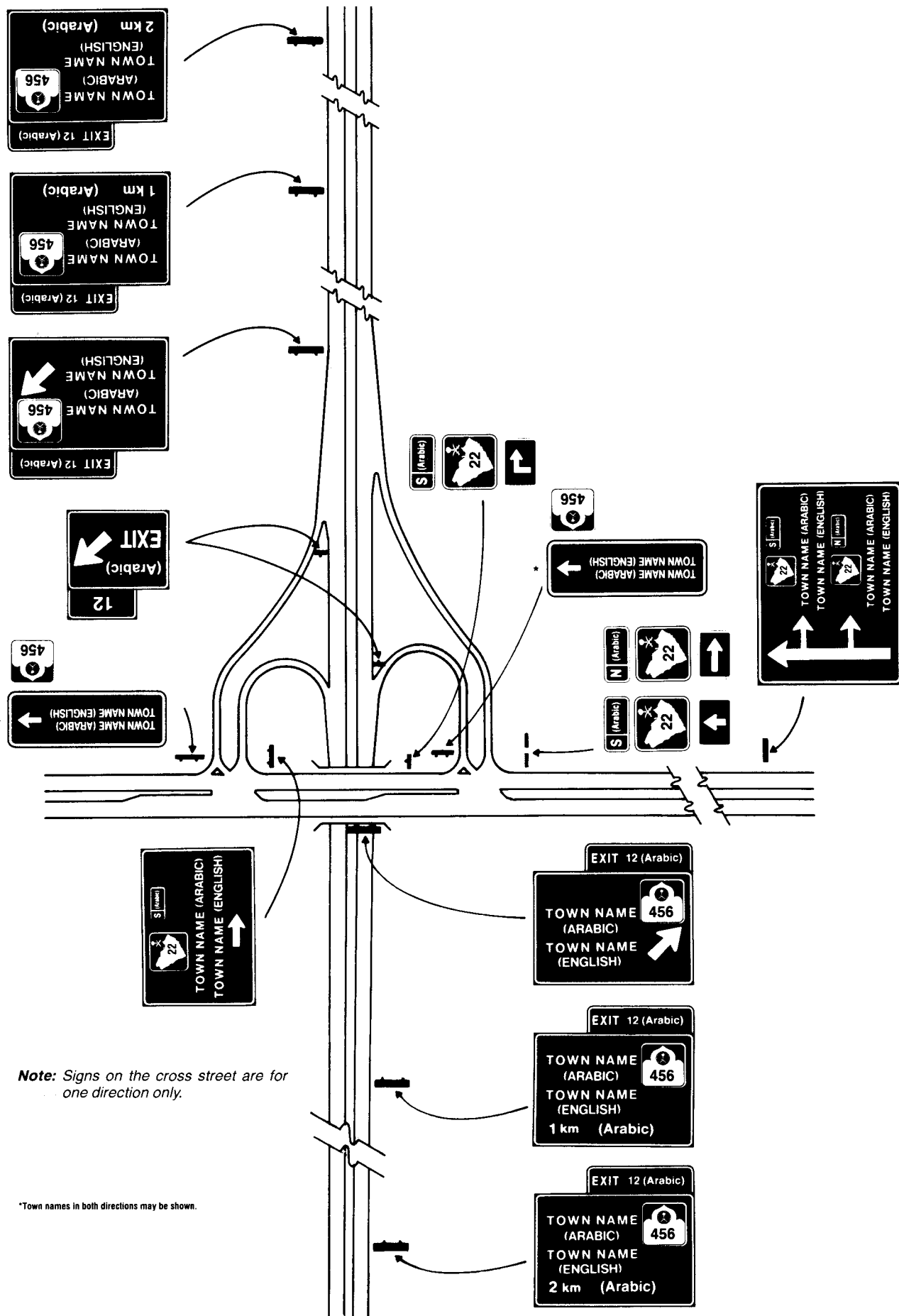


Figure 2-28  
Partial cloverleaf interchange.

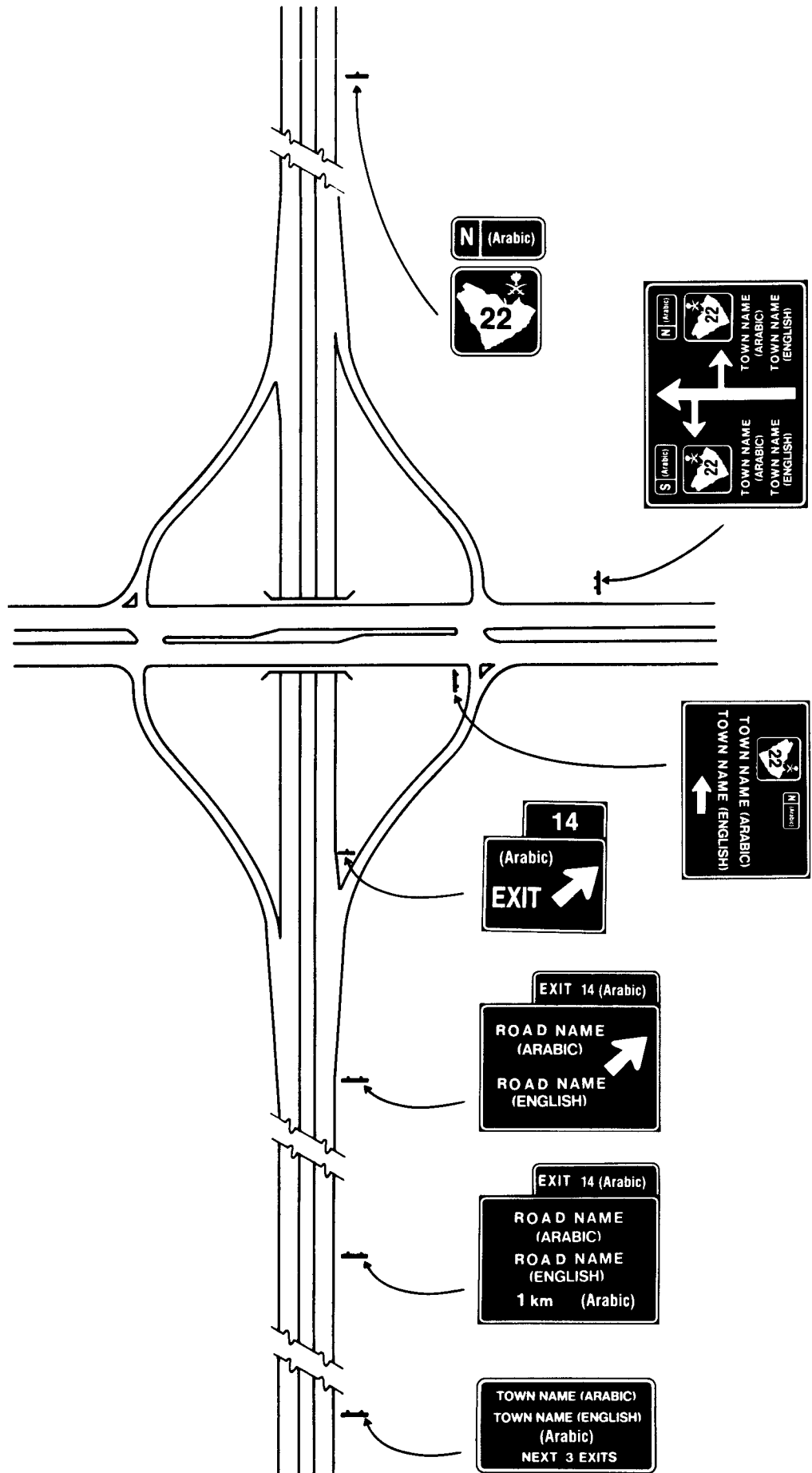


Figure 2-27  
Diamond interchange.

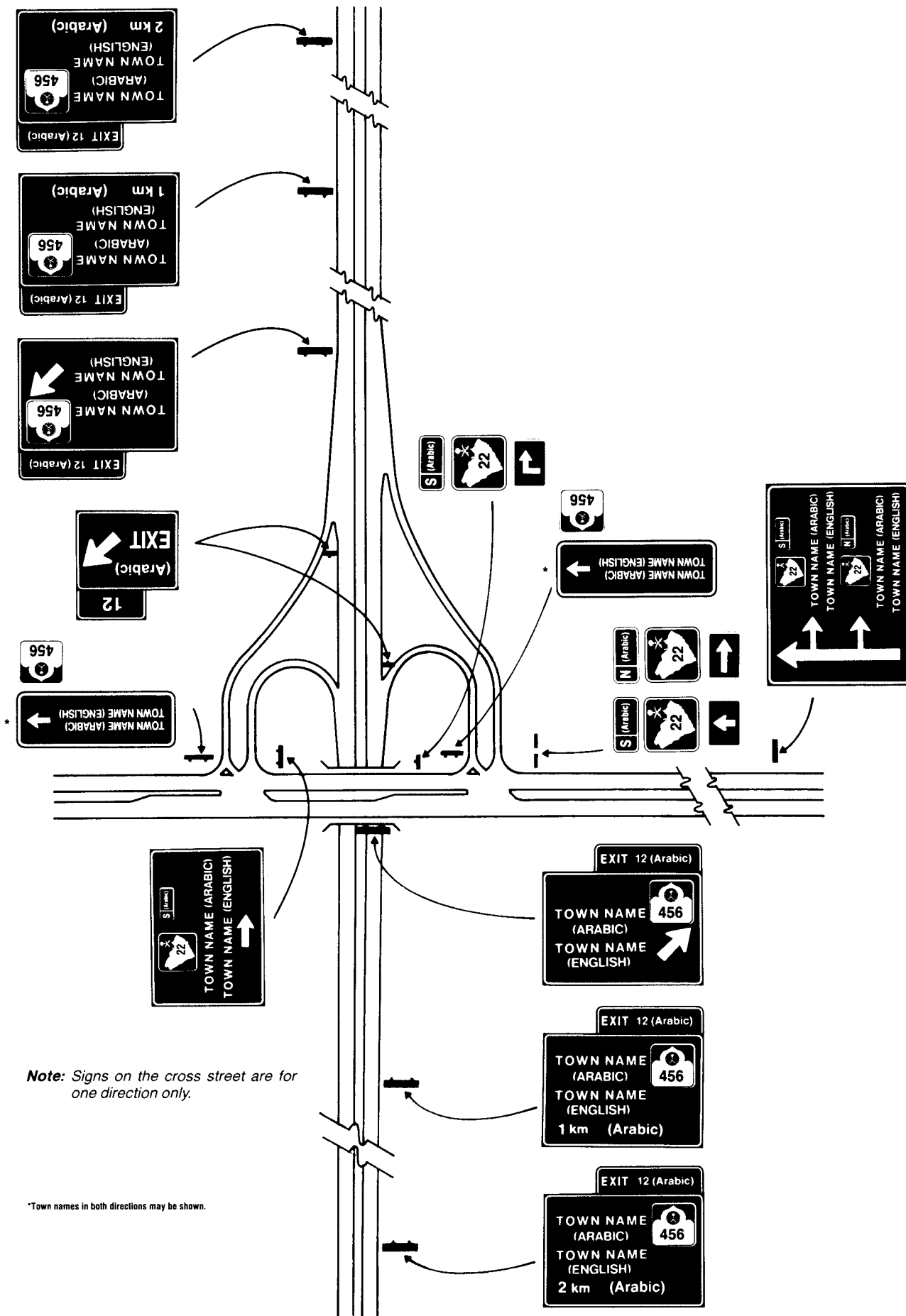


Figure 2-28  
Partial cloverleaf interchange.

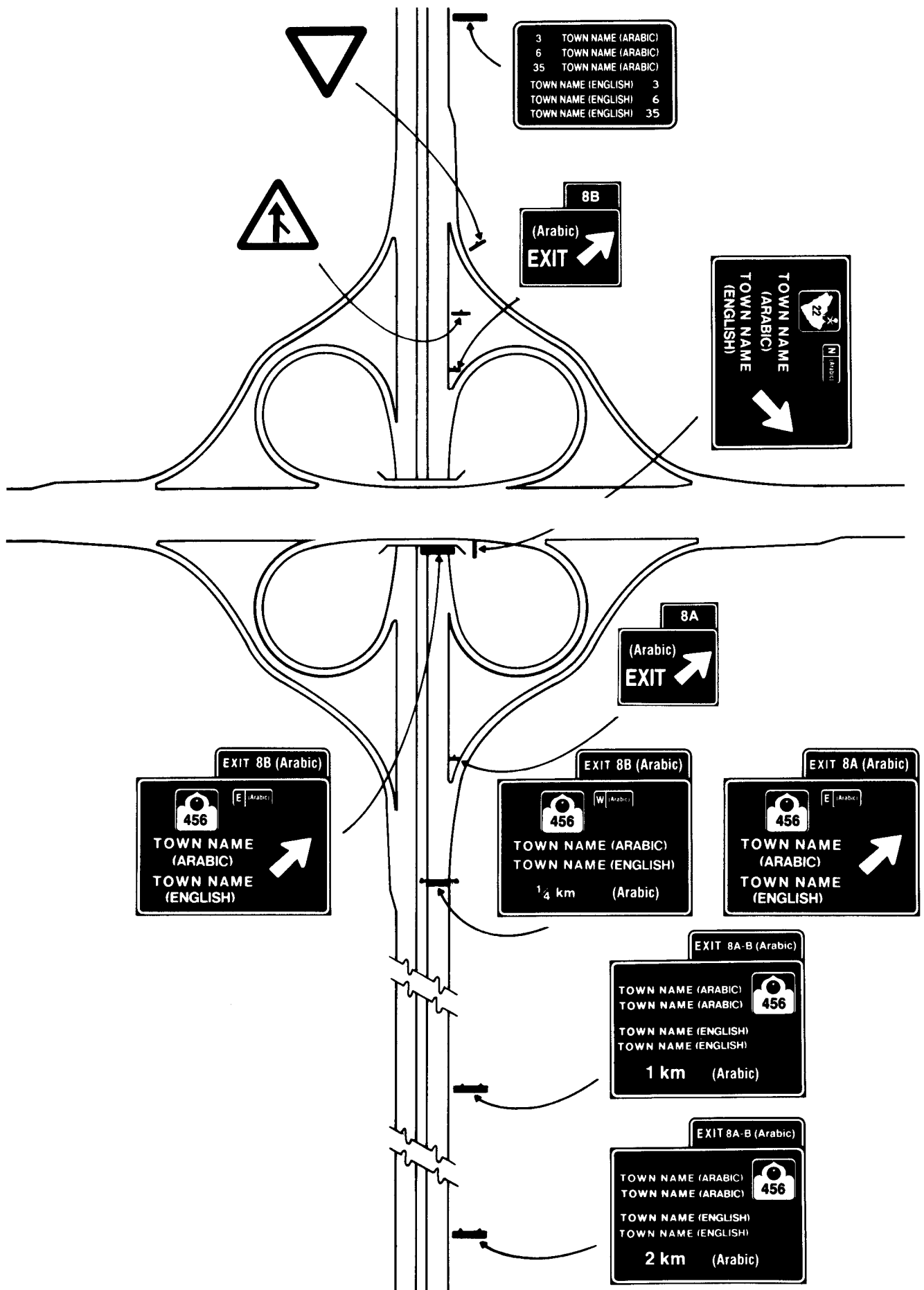


Figure 2-29  
Cloverleaf interchange.

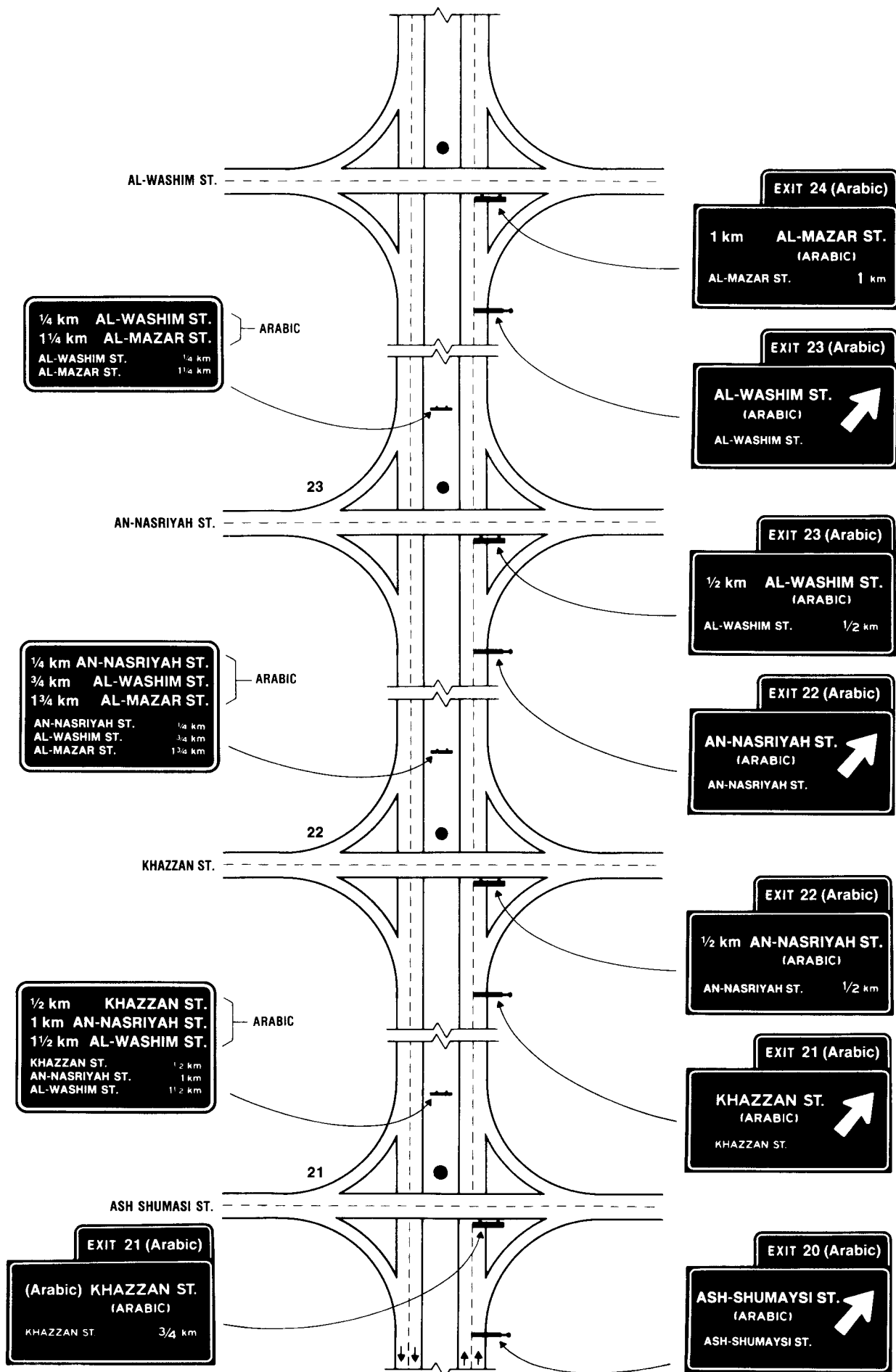


Figure 2-30  
Series of closely spaced interchanges using sequence signs and sign spreading.

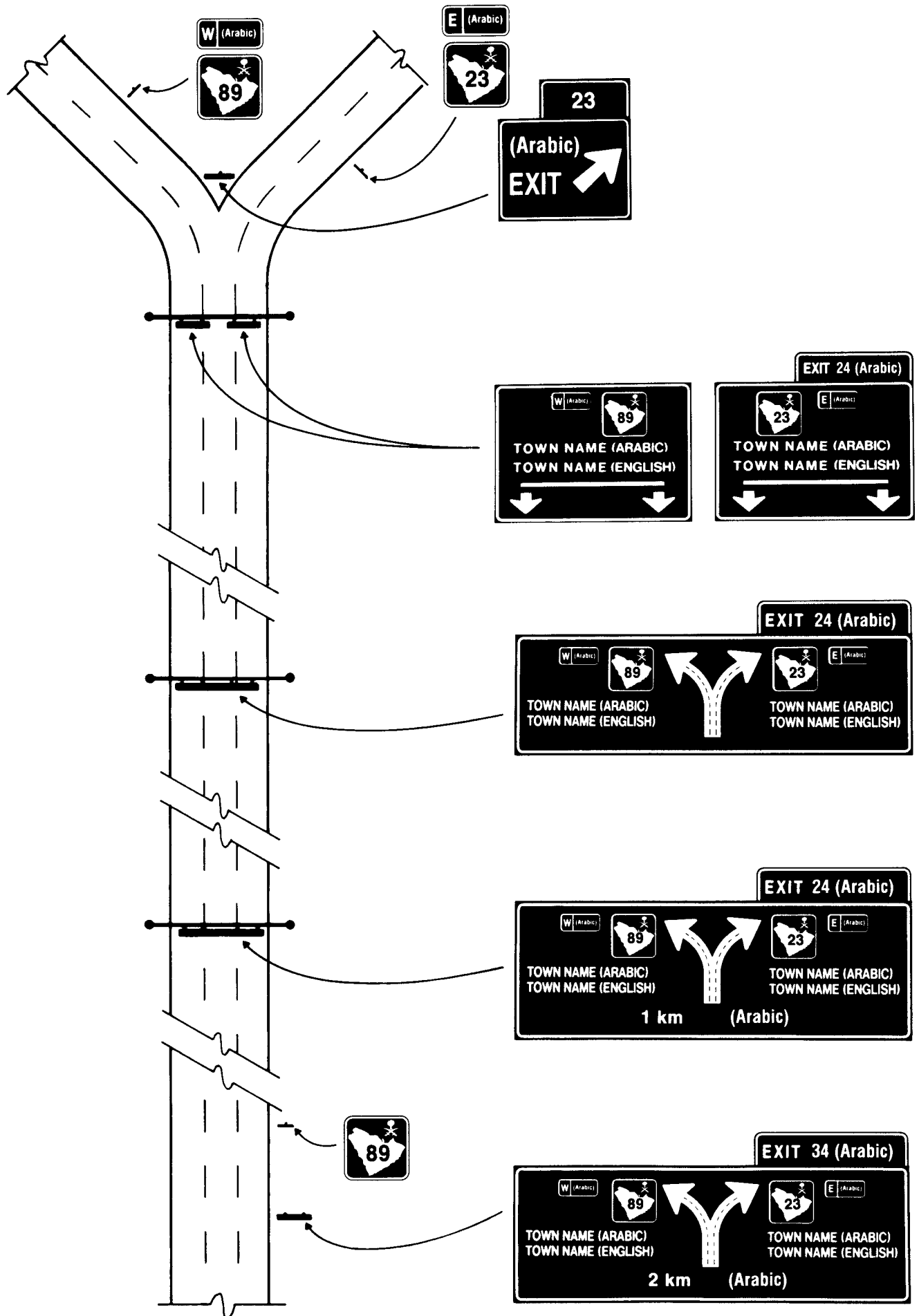


Figure 2-31  
Optional lane split (no overlapping routes).

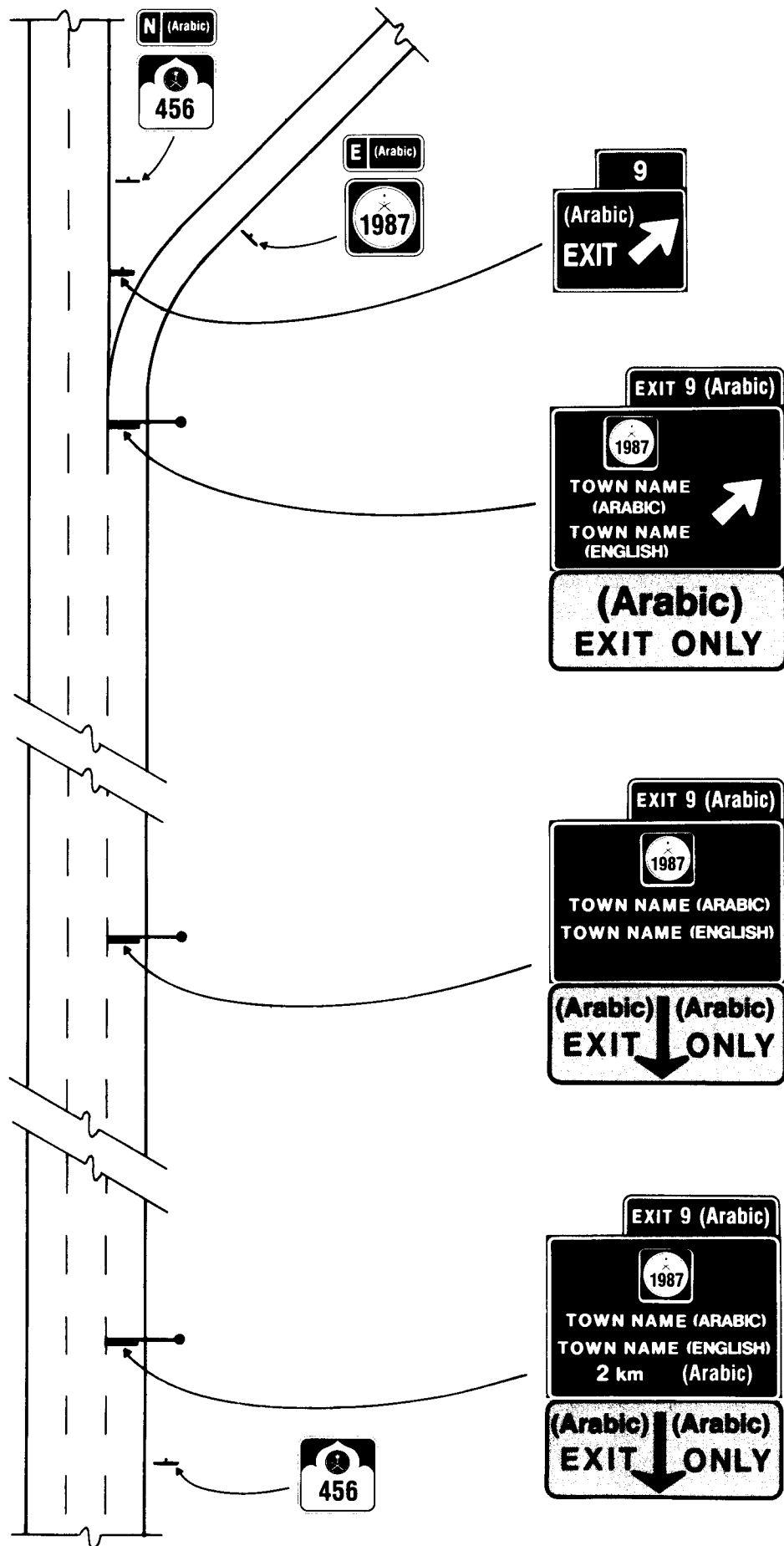


Figure 2-32  
EXIT ONLY on right (right-hand interchange lane drop).

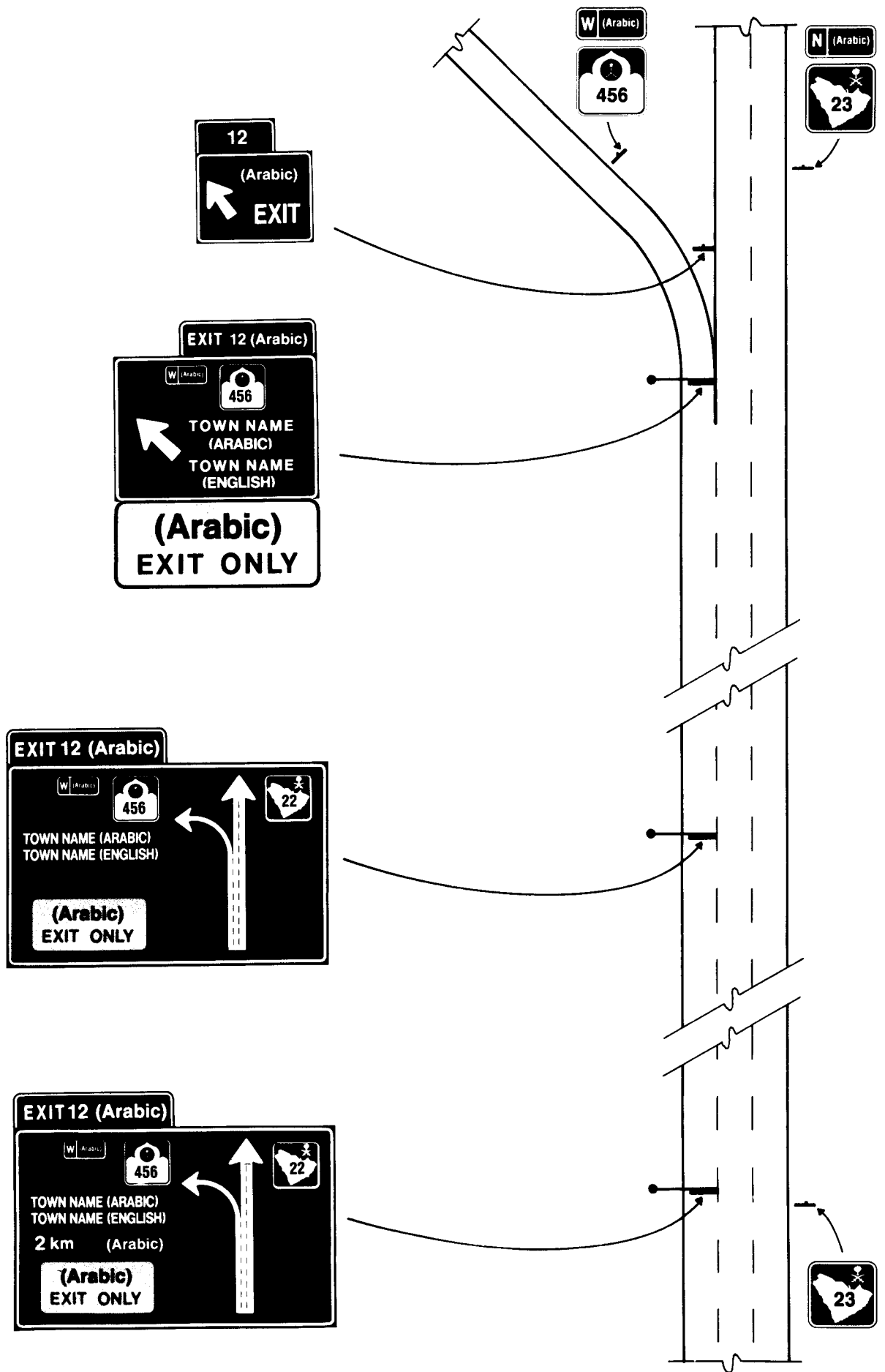


Figure 2-33  
EXIT ONLY on left with diagrammatic (left-hand interchange lane drop).

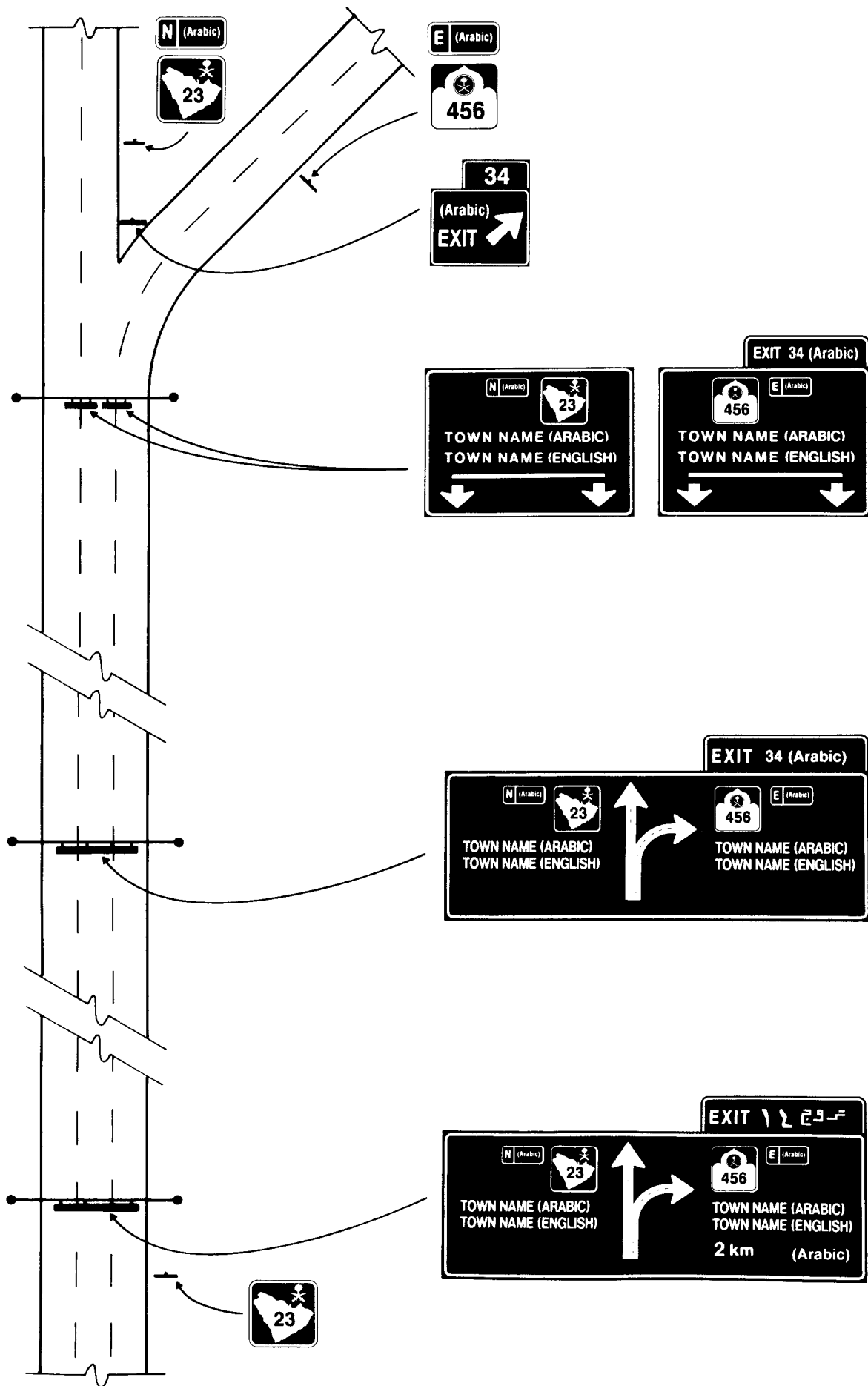


Figure 2-34  
Two-lane exit with optional lane.

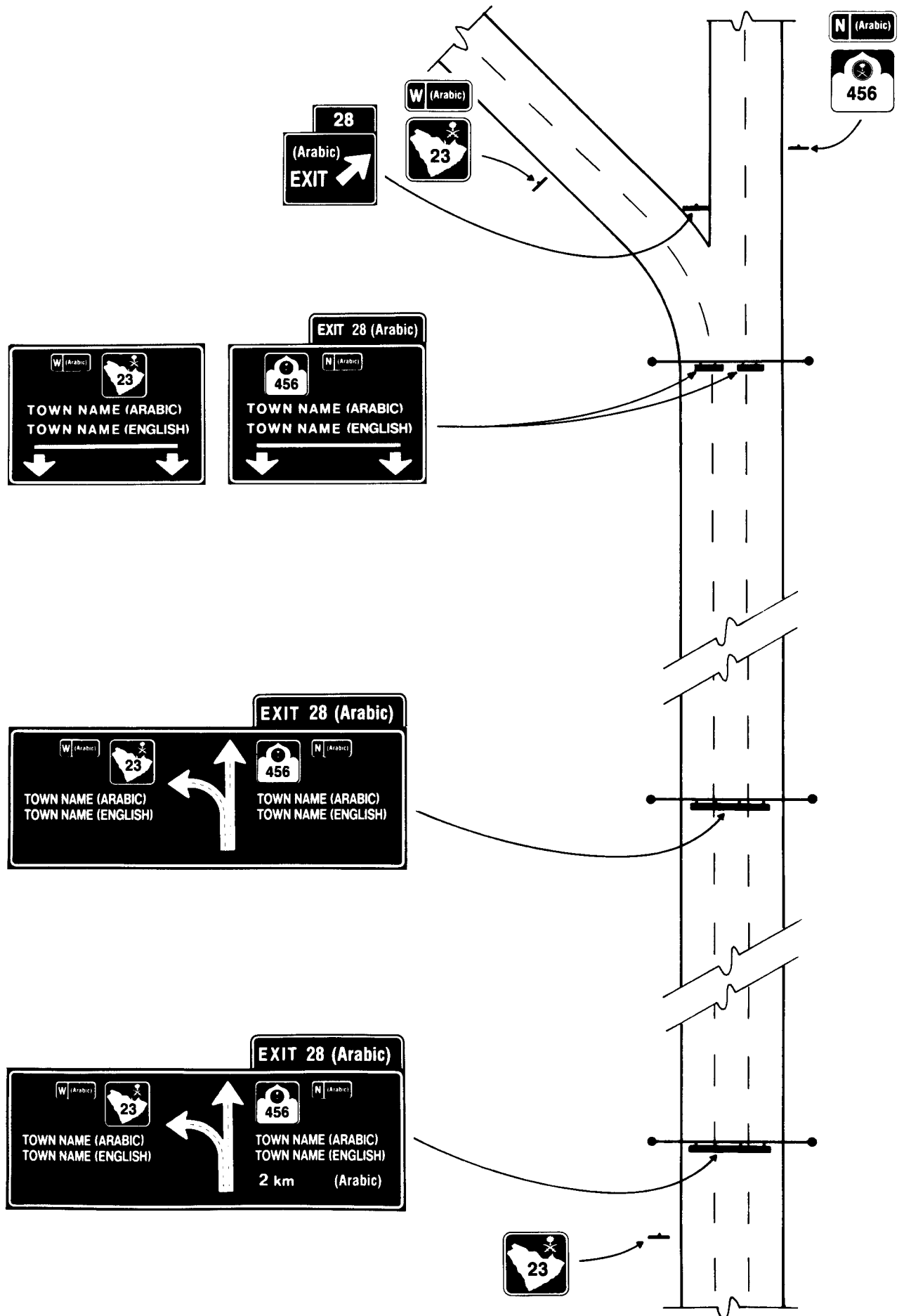



Figure 2-35  
Two-lane exit with optional lane and route discontinuity.

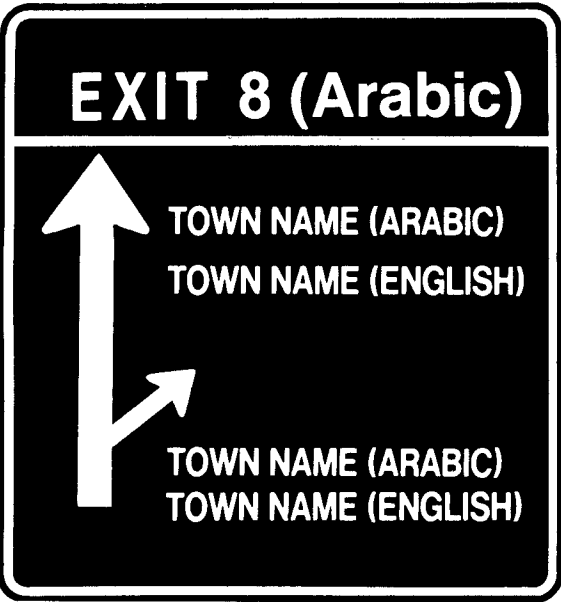
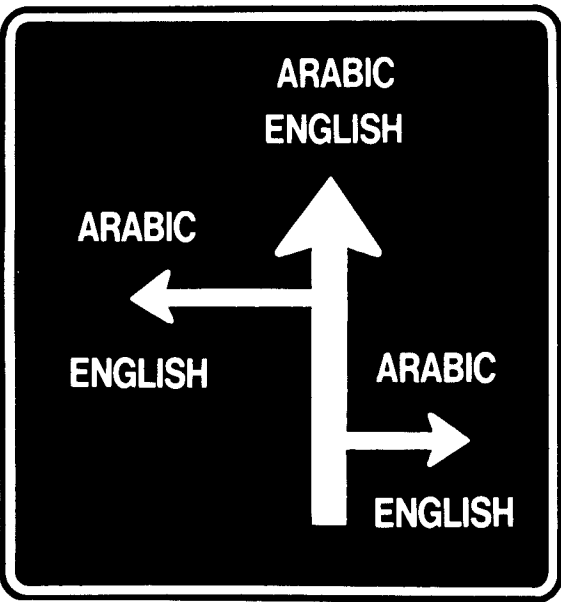


**EXIT 122 (Arabic)**

**TOWN NAME (ARABIC)**  
**TOWN NAME (ENGLISH)** 

**TOWN NAME (ARABIC)**  
**TOWN NAME (ARABIC)**  
**TOWN NAME (ENGLISH)**  
**TOWN NAME (ENGLISH)** 

**TOWN NAME (ARABIC)**  
**TOWN NAME (ARABIC)**  
**TOWN NAME (ARABIC)**  
**TOWN NAME (ENGLISH)**  
**TOWN NAME (ENGLISH)**  
**TOWN NAME (ENGLISH)** 



**Figure 2-37**  
**Typical direction signs.**

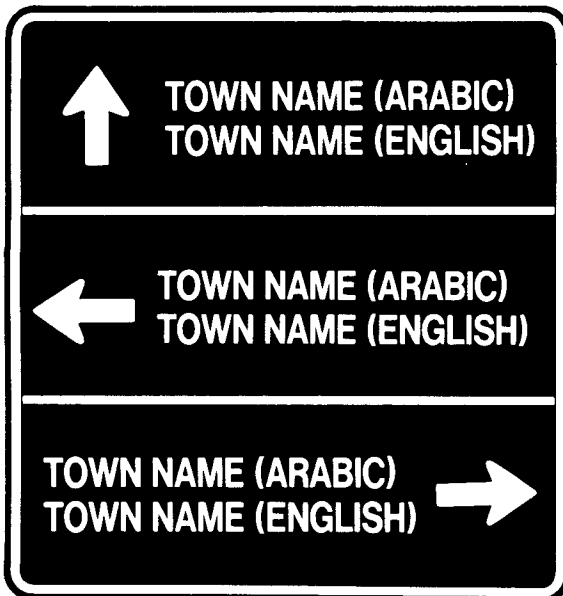
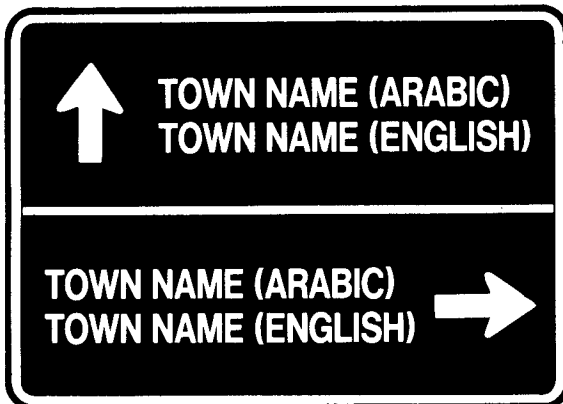
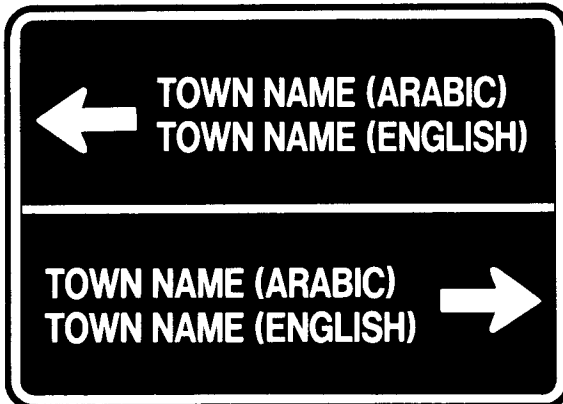
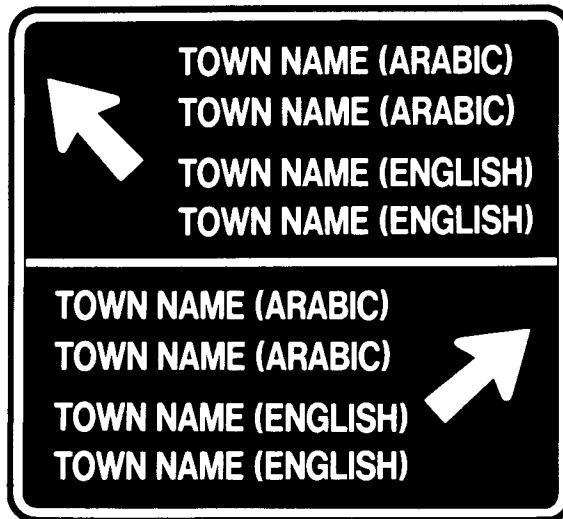
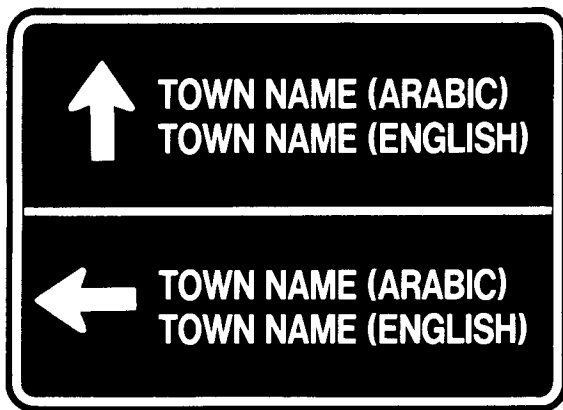


Figure 2-38  
Typical direction signs.

## Part 3. Markings

### 3.01 General Principles

#### A. Functions and Limitations

1. Markings have definite and important functions to perform in the overall area of traffic control. In some cases, markings are used to supplement the regulations or warnings of other devices such as traffic signs or signals. In other instances, markings can stand alone and do not need to be supplemented by other devices. The principal advantage of markings is that they convey guidance or information to the driver without diverting attention from the roadway.
2. Pavement markings have definite limitations. These may not be visible during sandstorms, fog, or rain. Also they may not be durable when subjected to heavy traffic.

#### B. Standardization of Application

1. Each standard marking shall be used only to convey the meaning prescribed for it in this Manual.
2. Markings that must be visible at night shall be reflectorized unless ambient illumination assures adequate visibility.

#### C. Materials

1. The most common material used for pavement markings is thermoplastic. Paint is frequently used for curb and object markings. However, other suitable marking materials are available. The materials used should provide the specified color throughout its useful life.
2. Individual raised pavement markers may be used to supplement longitudinal pavement markings. When used, raised pavement markers are arranged in patterns to simulate continuous or broken lines.

#### D. Colors

1. Markings shall be white and yellow in color.
2. These colors shall conform to the standard colors used for roadway signs.

#### E. General Principles—Longitudinal Pavement Markings

1. Longitudinal pavement markings shall conform to the following basic concepts:
  - a. Yellow lines delineate the separation of

traffic flowing in opposing directions.

- b. White lines mark the right edges of the pavement, delineate channelizing islands, and delineate lanes for traffic flowing in the same direction.

- c. Yellow markings are used to show places where parking is prohibited or restricted.

- d. A longitudinal marking consisting of a continuous line on the highway shall mean vehicles are not permitted to cross or straddle that line. A longitudinal marking consisting of two parallel continuous lines shall have the same meaning.

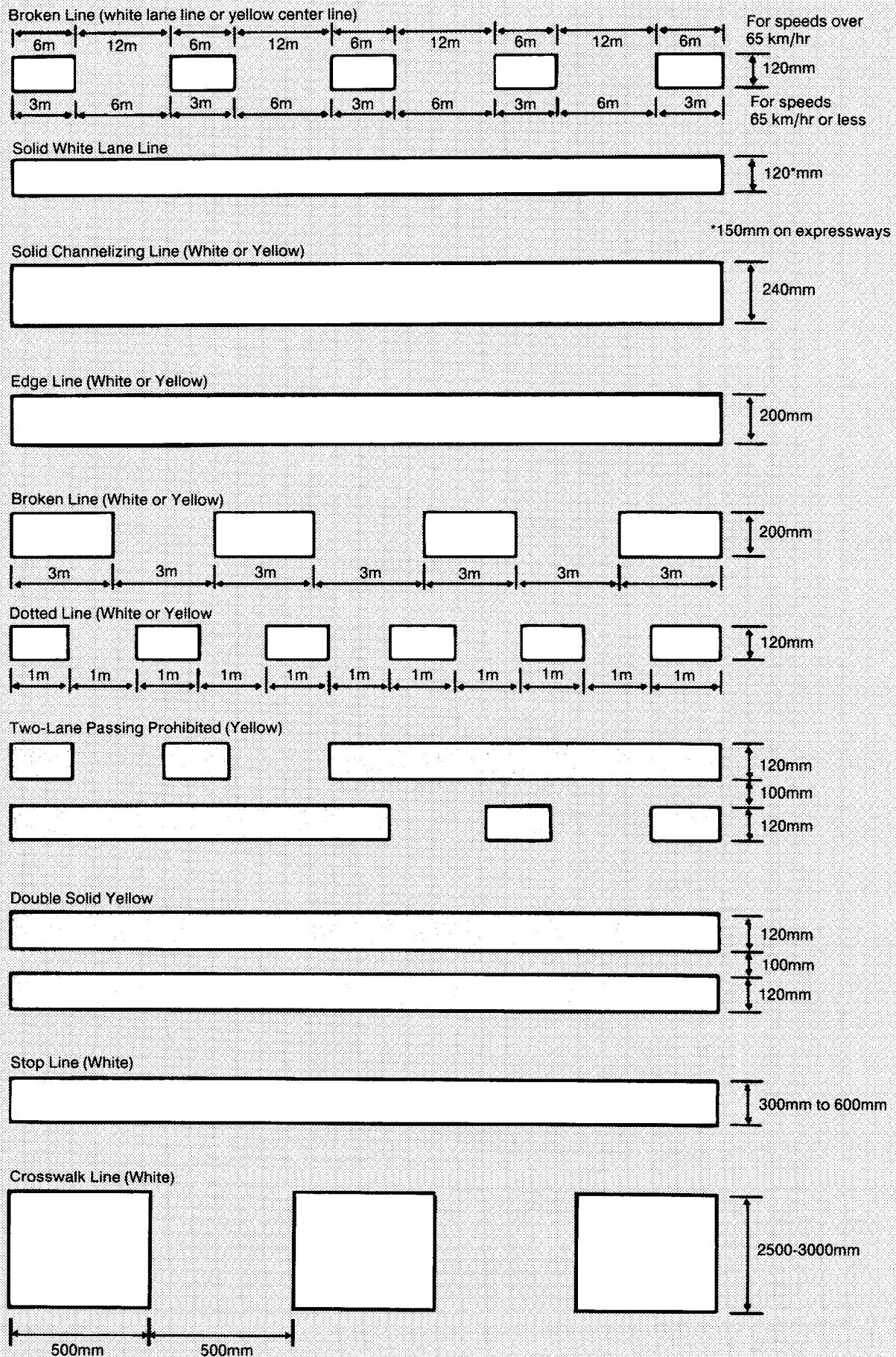
- e. A longitudinal marking consisting of a broken line on the highway is permissive in character, and vehicles may cross over that line.

- f. Width of line indicates the degree of emphasis.

#### F. Widths and Patterns of Longitudinal Lines

The widths and patterns of longitudinal lines shall be as follows:

1. The normal width of lane lines is 120 mm (150 mm on expressways).
2. A wide line shall be at least twice the width of a normal line.
3. A double line consists of two normal width lines separated by a clearly discernible space of approximately 100 mm, indicated by the contrast in color between the lines and the pavement surface.
4. A broken line is formed by segments and gaps, usually in the ratio of 1:2. The standard broken line pattern for roads with speeds greater than 65 km/h is 6 m segments and 12 m gaps. For urban roads having speeds 65 km/h or less the standard pattern is 3 m segments and 6 m gaps.
5. A dotted line is formed by short segments (normally 1.0 m in length) followed by gaps (normally 1.0 m in length) when used at low speed intersections. For interchanges or high speed intersections the pattern should be 3 m segments and 3 m gaps.
6. Edge lines shall have a width of 200 mm.



**Figure 3-1**  
Typical pavement marking lines and patterns.

#### **G. Transverse Markings**

1. Transverse markings, arrows, symbols, and inscriptions shall be white.
2. Transverse markings consist of one or more continuous lines across one or more traffic lanes.
3. Pedestrian crossings and STOP lines are uses of transverse markings.

#### **H. Curb Markings**

1. Curb markings fall into two categories: roadway delineation and parking regulations.
2. Reflectorized unbroken yellow shall be placed on the curbs of islands located in the line of traffic flow where the curb serves to channel traffic to the right of the obstruction. Reflectorized unbroken white shall be used when traffic may pass on either side of the island.
3. Reflectorized yellow shall be placed on the curb or adjacent to the curb with a zigzag where restricted parking regulations apply. Standard signs shall accompany the markings.

1

2

3

4

## 3.02 Applications of Pavement and Curb Markings

### A. Center Lines

1. A center line separates traffic traveling in opposite directions. It need not be at the geometrical center of the pavement. Center lines provide important guidance to motorists and should be used on most paved roads. On roads where a continuous center line is not used, short sections may be used to control the position of traffic at specific locations, such as around bends, over hills, and on approaches to intersections, railroad crossings, and bridges.
2. The center line markings on two-lane, two-way highways shall be either
  - a. a normal broken yellow line where passing is permitted,
  - b. a double line consisting of a normal broken yellow line and a normal continuous yellow line where passing is permitted in one direction, or
  - c. a double line consisting of two normal continuous yellow lines where passing is prohibited in both directions.
3. The center line on undivided highways, where four or more lanes are always available, is always a double continuous yellow line.
4. On three-lane rural highways where a truck climbing lane has been added to a two-lane facility, two lanes should be designated for traffic in one direction and marked as illustrated in Figure 3-2.
5. Center lines are required on paved highways under the following conditions:
  - a. In rural districts on a two-lane pavement 6 m or more in width with prevailing speeds of greater than 60 km/h.
  - b. In residence or business districts on all through highways, and on other highways where significant traffic volumes exist.
  - c. On all undivided pavements of four or more lanes.
  - d. At other locations where an engineering study indicates a need.
  - e. On detours—permanent for long periods, temporary type for short periods (See Part 5).

Application of center lines are shown in various illustrations herein, particularly Figures 3-2, 3-3 and 3-4.

### B. Lane Lines

1. Lane lines separate lanes of traffic traveling in the same direction. These lines shall be used on all multi-lane highways and should be used at congested locations where the roadway will accommodate more lanes of traffic than would be the case without the use of lane lines.
2. Lane lines are usually normal width broken white lines which permit lane changing with care.
3. A normal solid continuous white line may be used as the lane line in critical areas where it is advisable to discourage lane changing. Typical locations for such applications are tunnels or bridges having width restrictions and interchange areas where lane changing disrupts traffic flow.
4. A continuous white line may be used to separate through traffic lanes from special secondary lanes, such as uphill truck lanes, left or right turn lanes, and transit bus lanes.

Applications of lane lines are illustrated in Figures 3-2, 3-3 and 3-4.

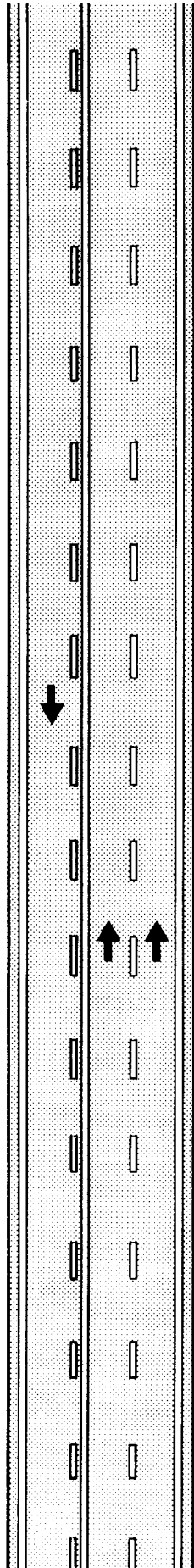
### C. Pavement Edge Lines

1. Pavement edge line markings provide an edge-of-pavement guide for drivers. These lines have a unique value as a visual reference for the guidance of drivers during adverse weather and visibility conditions. The lines also may be used where edge delineation is desirable to reduce driving on paved shoulders or refuge areas of lesser structural strength than adjacent pavement. Edge lines shall not be continued through intersections and should not be broken for driveways.
2. Edge lines on undivided roads shall be white. Edge lines on divided roads shall be yellow on the left side and white on the right side.

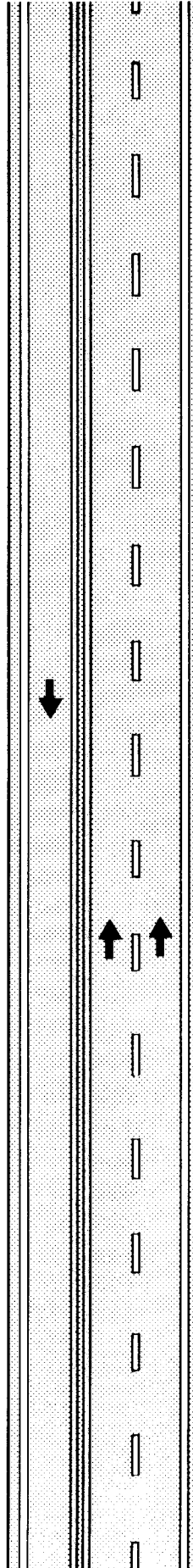
### D. No-Passing Zone Markings

1. Where center lines are installed, no-passing zones shall be established at vertical and horizontal curves and elsewhere on two-lane highways where an engineering study indicates passing must be prohibited because of inadequate sight distances or other special conditions.
2. A no-passing zone shall be marked by either a one direction, no-passing marking or a two direction, no-passing marking as illustrated in Figure 3-2.

a—Typical two-way marking where motorists in a single lane are permitted to pass.

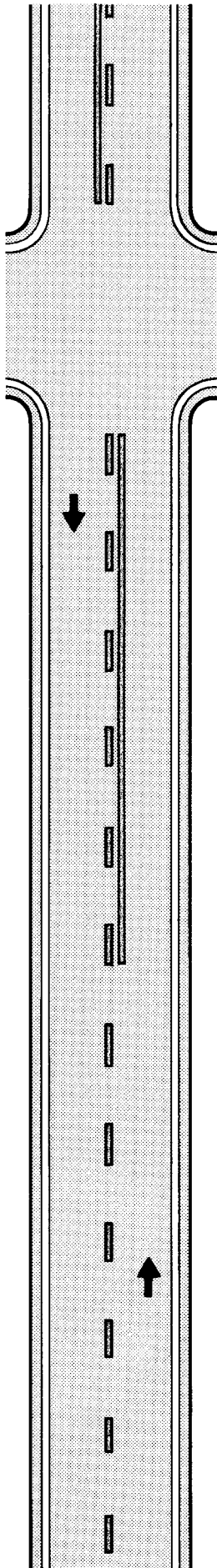


b—Typical two-way marking where motorists in a single lane are not permitted to pass.



**Figure 3-2**  
Typical three-lane, two-way marking application.

a—Typical two-lane, two-way marking with passing permitted.



b—Typical two-lane, two-way marking with passing prohibited zones.

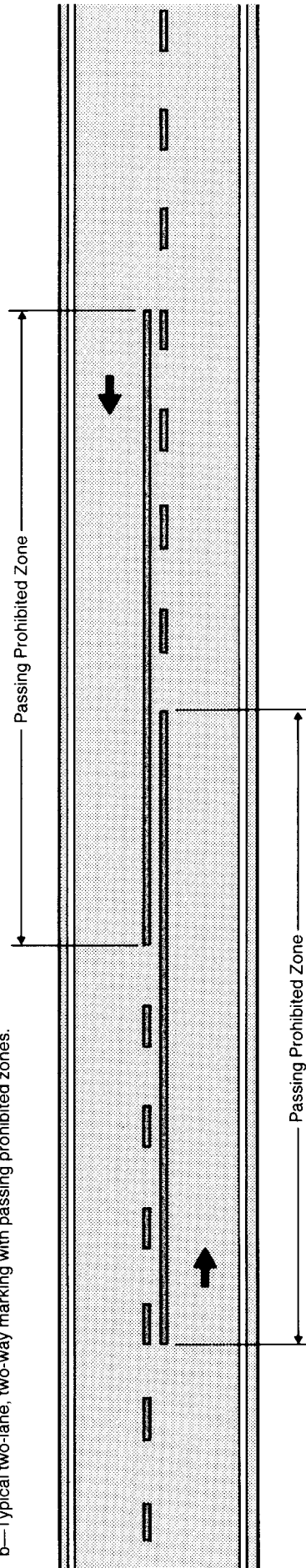


Figure 3-3

Typical two-lane, two-way marking application.

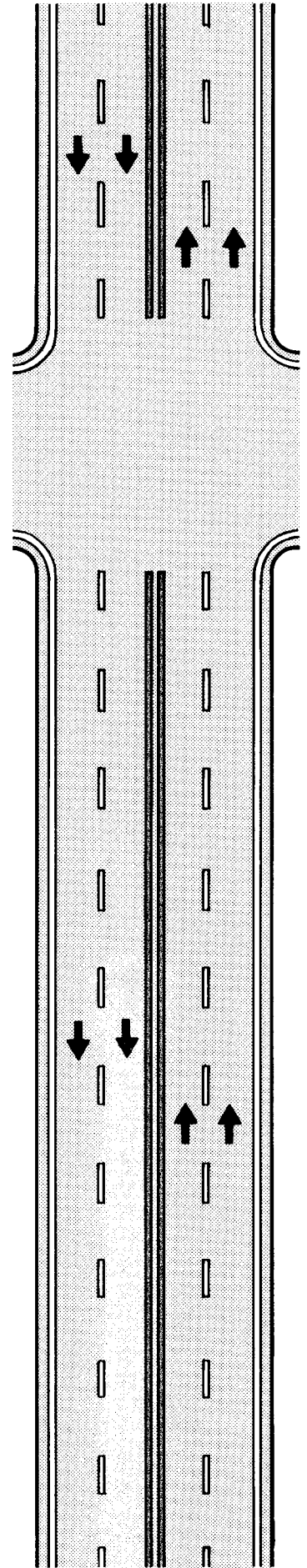
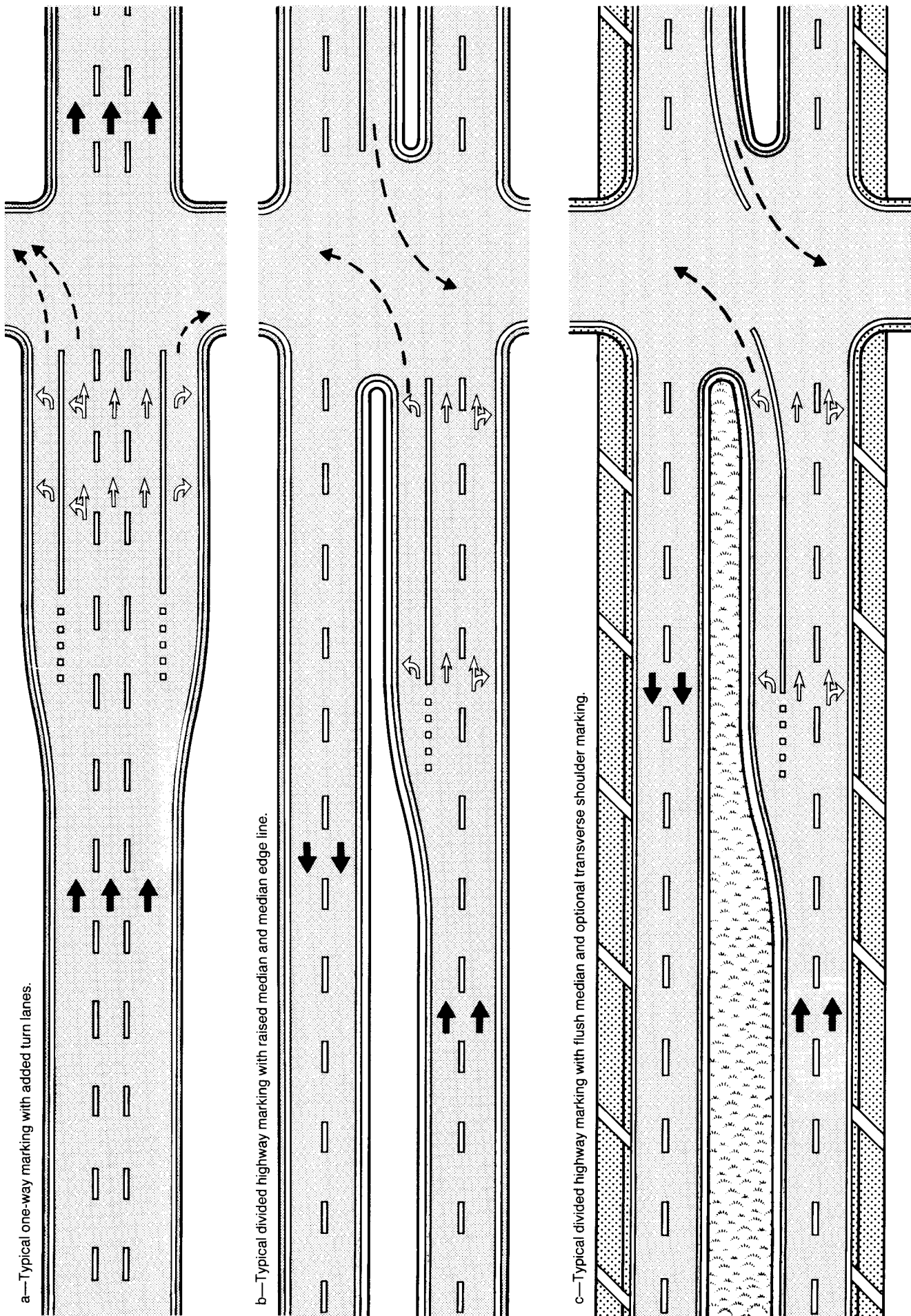


Figure 3-4

Typical multi-lane, two-way markings.



**Figure 3-5**  
**Typical one-way and divided highway marking application.**

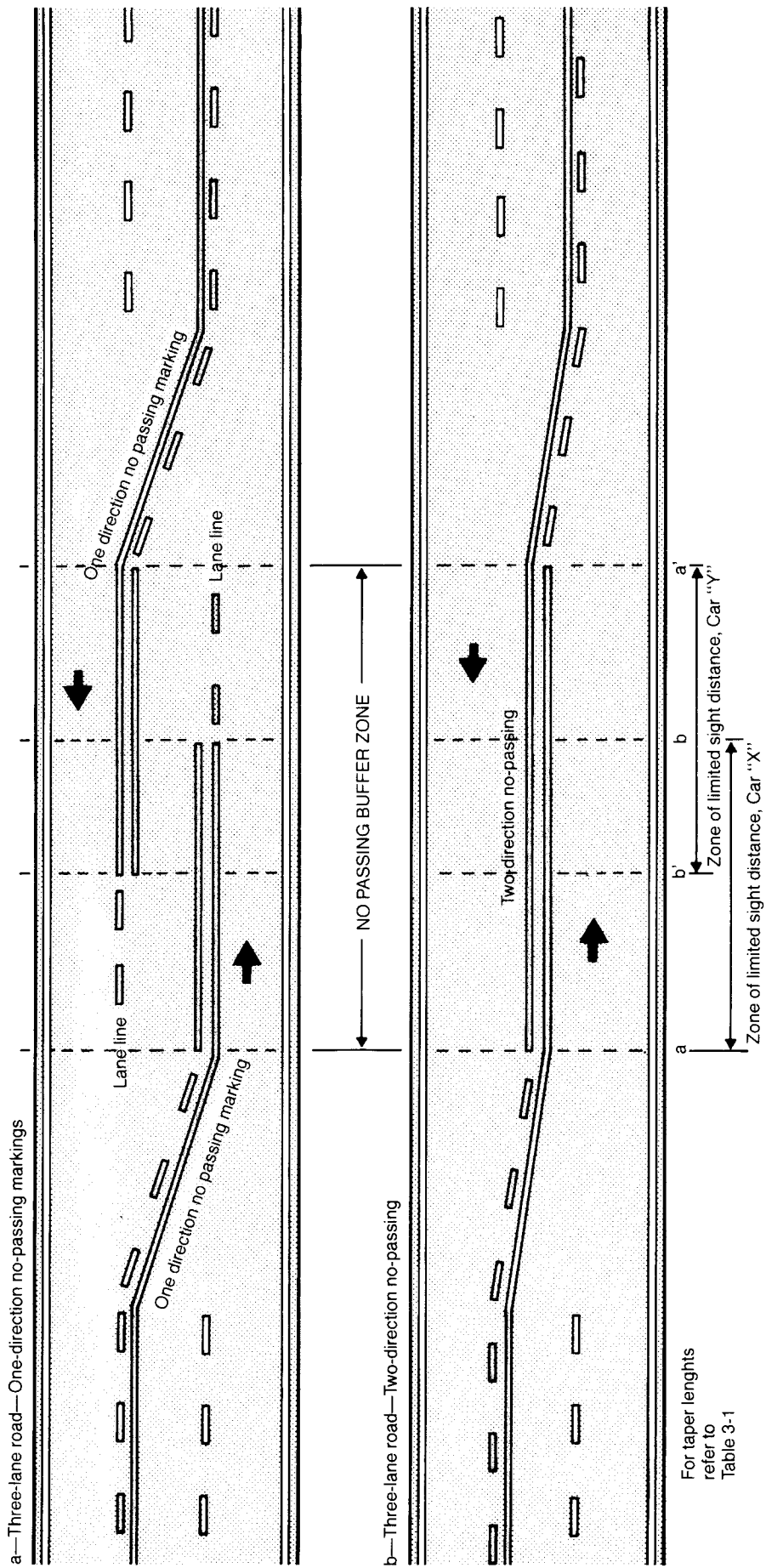
### E. Application of No-Passing Zone Markings

1. On a two-lane highway, the no-passing marking shall be parallel to and extended along the center line throughout the no-passing zone.
2. On a three-lane highway where the right lanes are being transitioned into one lane, a no-passing buffer zone shall be provided. This shall be done by transitioning the center line markings diagonally across the center lane to the beginning of the no-passing buffer zone, and thence along this location to the end of the buffer zone (Figure 3-6). The markings shall extend across the center lane on a diagonal for a distance (taper length). (See Table 3-1).
3. In addition to the pavement marking where prescribed, Overtaking Prohibited signs (Section 2.03 D 25) shall be used to emphasize the existence and extent of a no-passing zone.
4. Where the distance between successive no-passing zones is less than 120 m, the appropriate no-passing marking (one direction or two direction) should connect the zones.
5. The no-passing marking is also used on two-way roadways at pavement width transitions and on approaches to obstructions which must be passed on the right. It may

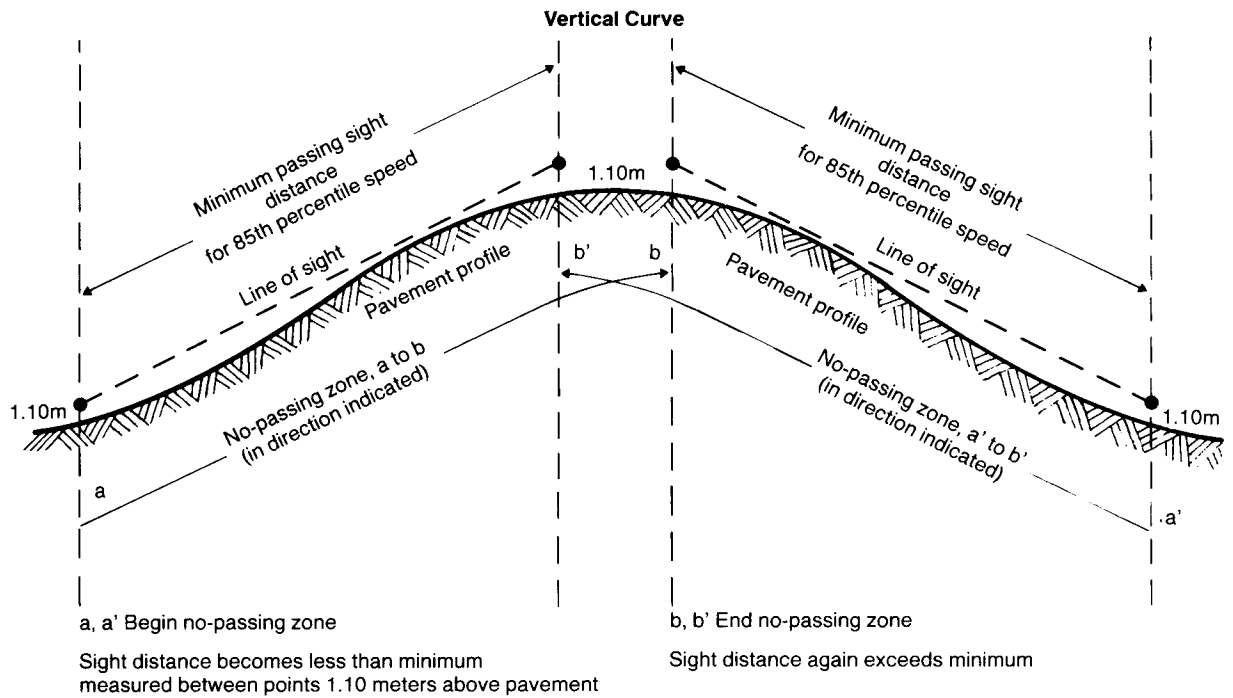
also be used on approaches to railroad grade crossings and other locations where passing should be prohibited.

**Table 3-1**  
**Taper Lengths in Meters for**  
**Required Lateral Movement**

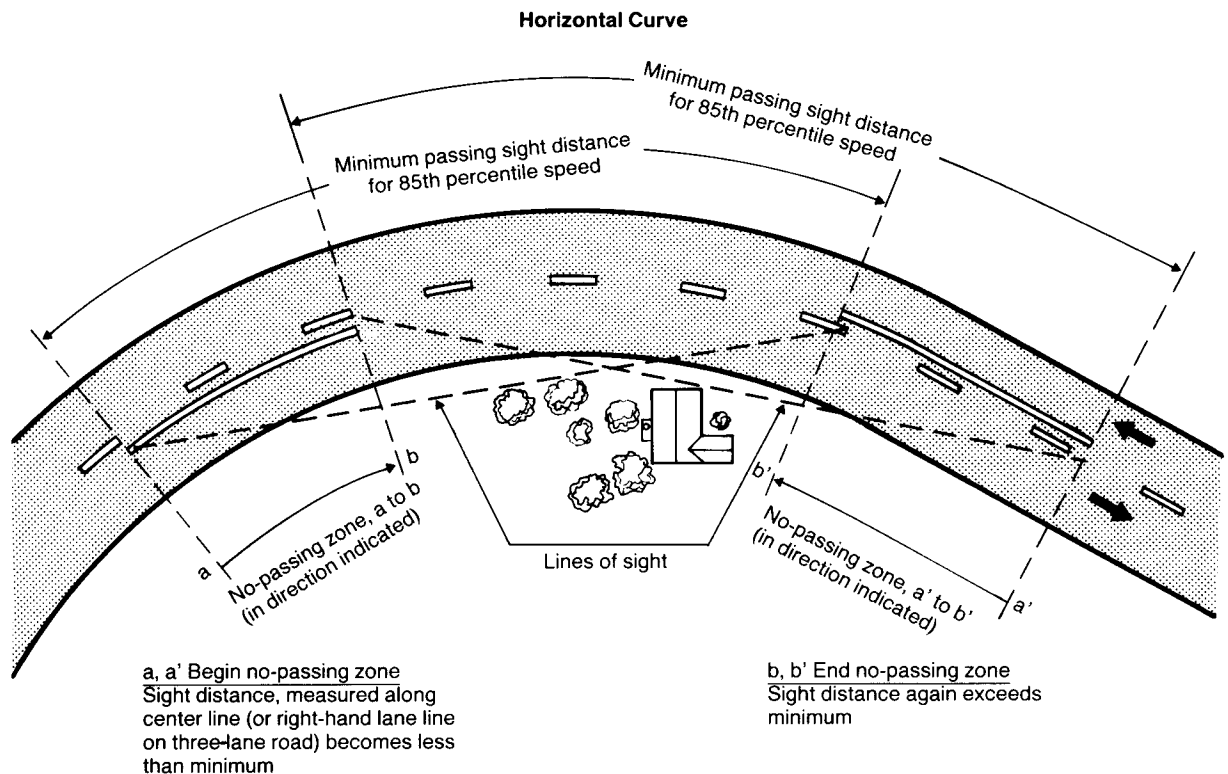
Speed km/h	Distance in Meters that Traffic is to be Moved R or L						
	1.5	2.5	2.75	3.0	3.25	3.5	3.75
30	9	15	16	17	19	20	22
35	11	20	22	24	26	28	30
40	15	26	28	31	34	36	39
45	20	33	36	39	42	46	49
50	24	40	44	48	52	56	60
55	29	49	54	58	63	68	73
60	35	58	64	70	75	81	87
65	41	68	75	82	88	95	102
70	65	109	102	131	141	152	163
75	70	117	128	140	152	163	175
80	75	124	137	149	162	174	186
85	79	132	145	158	172	185	198
90	84	140	154	168	182	196	210
95	89	148	162	177	192	207	221
100	93	155	171	186	202	218	233
105	98	163	179	196	212	228	245
110	103	171	188	205	222	239	256
115	107	179	197	214	232	250	268
120	112	184	205	224	242	261	280



**Figure 3-6**  
Standard three-lane, two-way pavement marking for alternating preferred direction of two lanes.



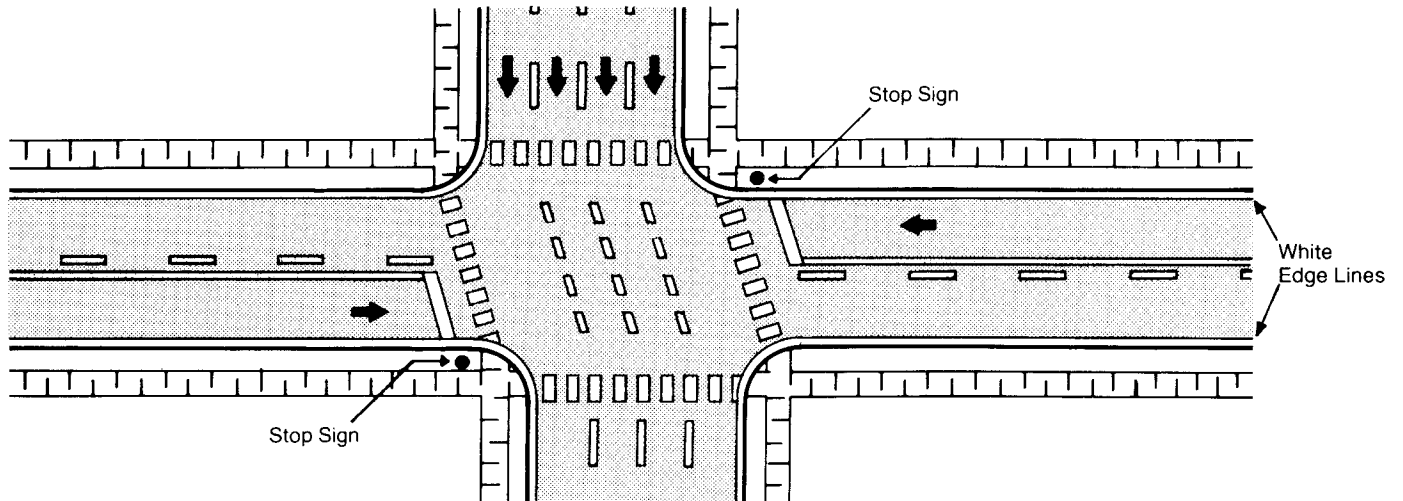
Note: No-passing zones in opposite directions may or may not overlap, depending on alignment.



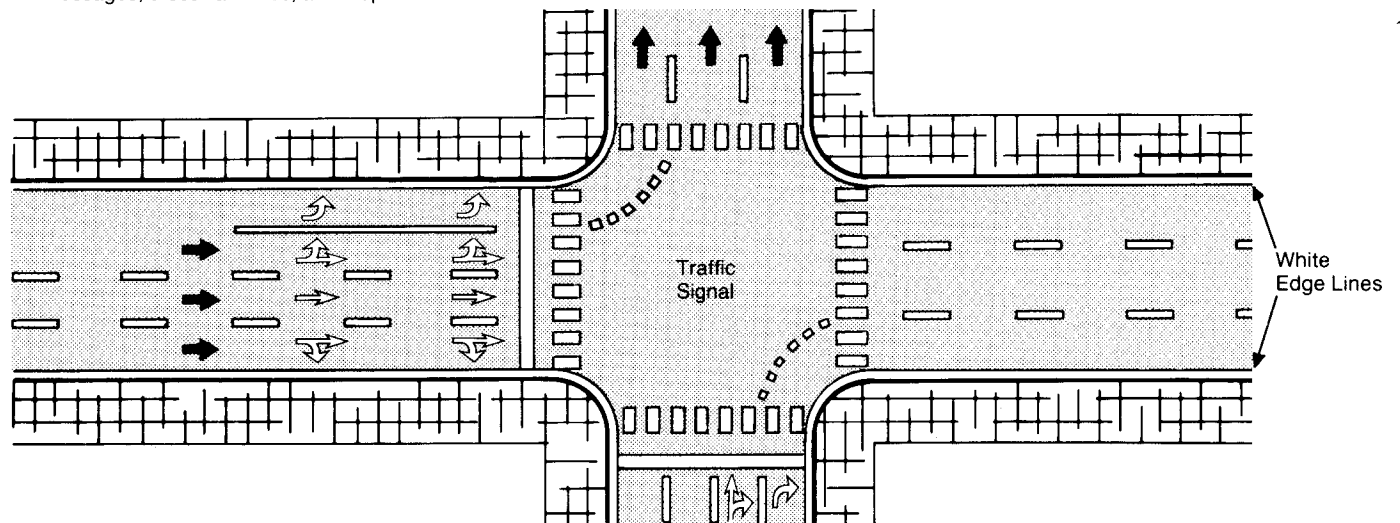
Note: No-passing zones in opposite directions may or may not overlap, depending on alignment.

**Figure 3-7**  
**Method of locating and determining the limits of no-passing zones at vertical and horizontal curves.**

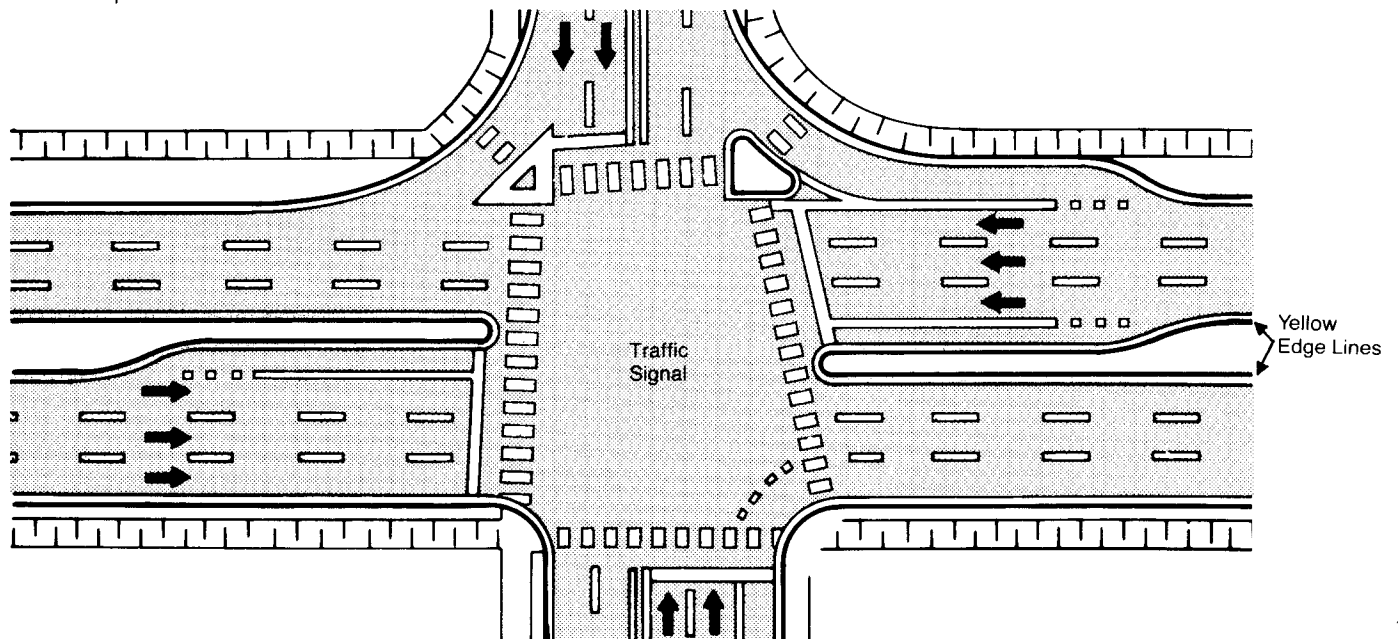
a—Typical pavement marking with offset lane lines continued through the intersection and optional crosswalk lines and stop limit lines.



b—Typical pavement marking with optional double turn lane lines, pavement messages, crosswalk lines, and stop limit lines.

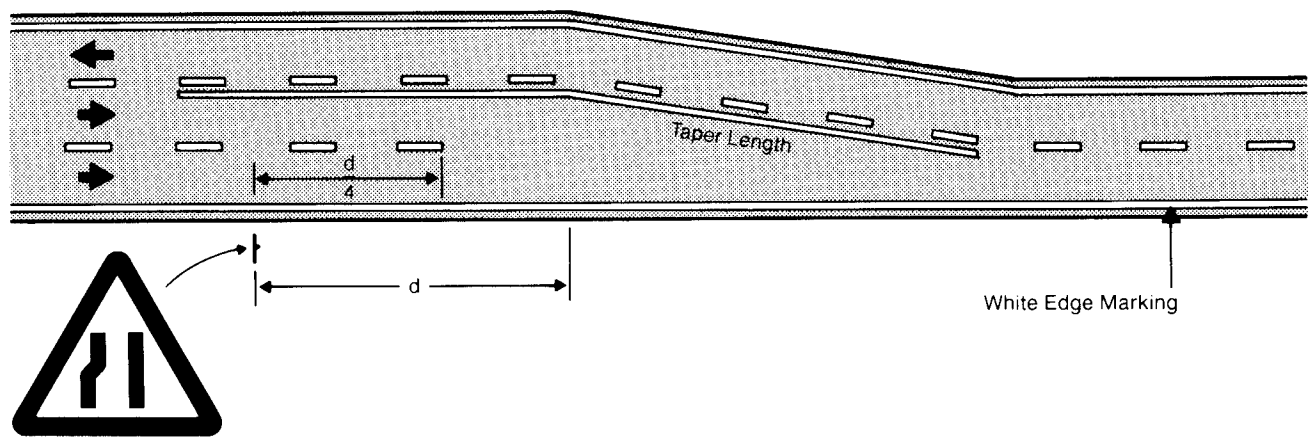


c—Typical pavement marking with optional turn lane lines, crosswalk lines, and stop limit lines.

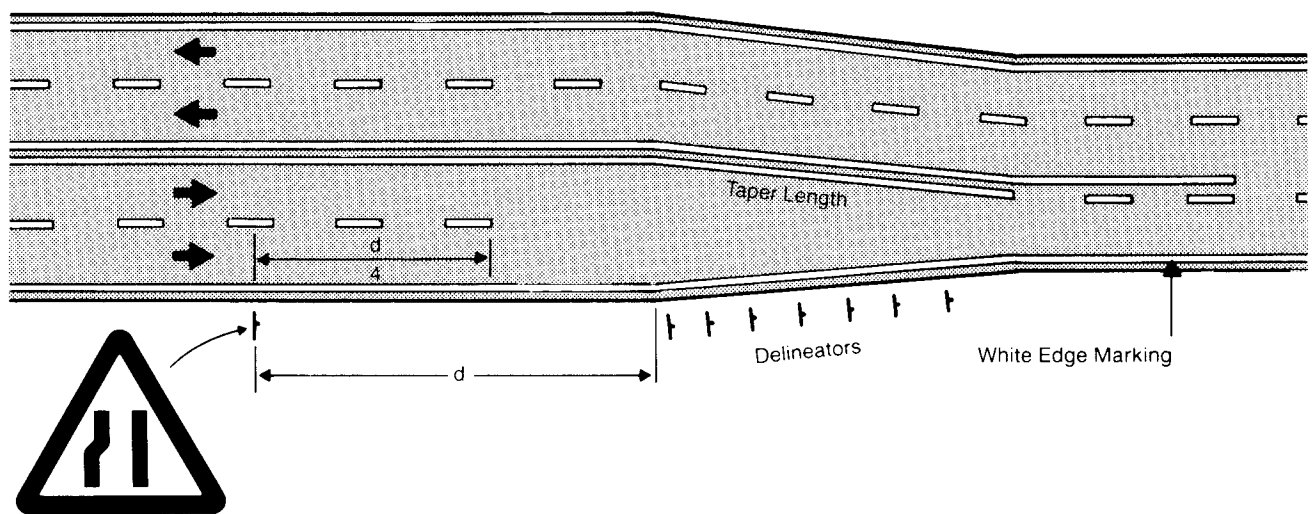


**Figure 3-8**  
Typical pavement marking application.

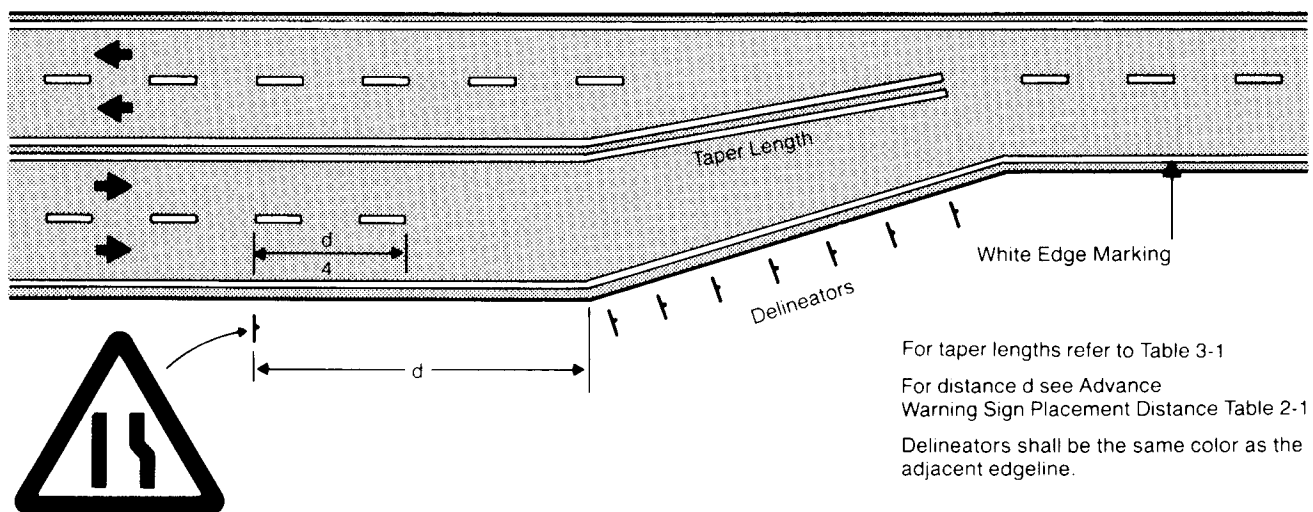
a—From three lanes to two lanes



b—From four lanes to three lanes



c—From four lanes to two lanes

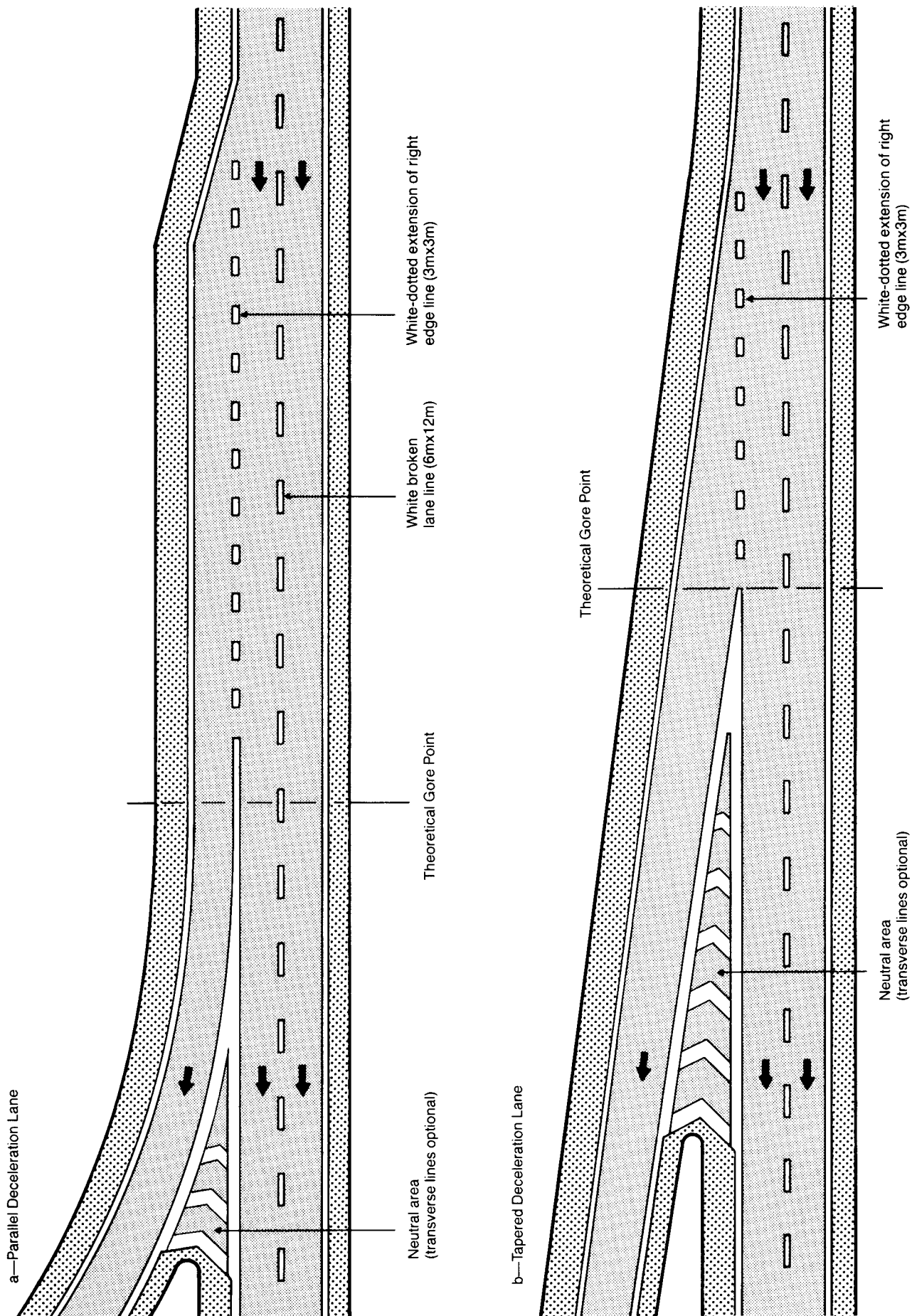


For taper lengths refer to Table 3-1

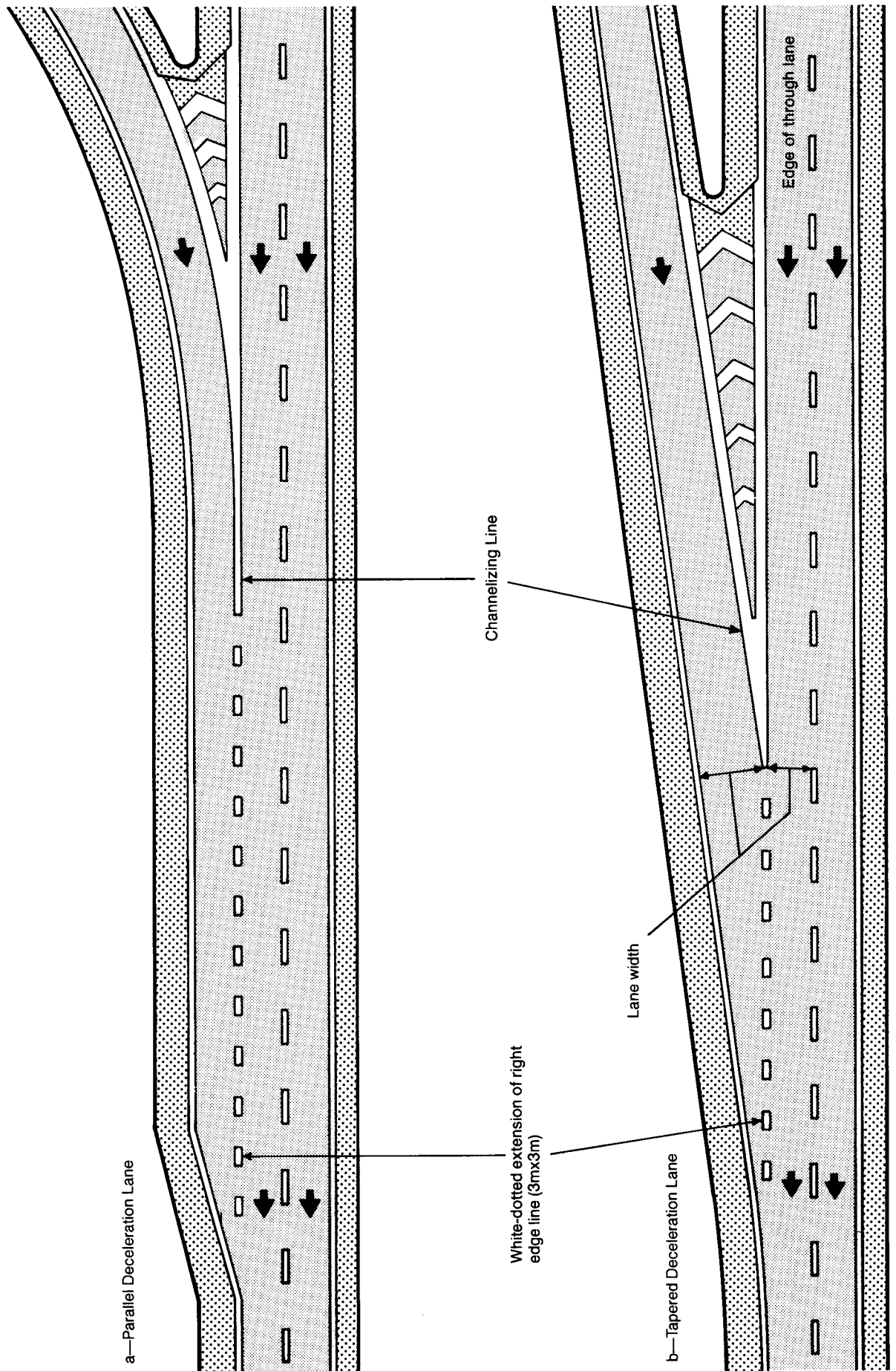
For distance d see Advance  
Warning Sign Placement Distance Table 2-1

Delineators shall be the same color as the  
adjacent edgeline.

**Figure 3-9**  
**Typical lane reduction transition markings and signs.**



**Figure 3-10**  
Typical exit ramp markings.



**Figure 3-11**  
Typical entrance ramp markings.

## F. Warrants for No-Passing Zones at Bends

1. A no-passing zone at a horizontal bend or vertical curve is warranted where the sight distance, as defined below, is less than the minimum necessary for safe passing at the prevailing speed of traffic. Passing sight distance on a vertical curve is the distance at which an object 1.10 m above the pavement surface can just be seen from a point 1.10 m above the pavement (Figure 3-7). Similarly, passing sight distance on a horizontal bend is the distance measured along the center line between two points 1.10 m above the pavement on a line tangent to the embankment or other obstruction that cuts off the view on the inside of the bend (Figure 3-7). Where center lines are installed and a bend warrants a no-passing zone, it should be so marked where the sight distance is equal to or less than that listed below for the prevailing off-peak 85 percentile speed:

85 Percentile Speed (km/h)	Minimum Passing Sight Distance (meters)
50	150
60	180
70	210
80	240
90	270
100	300
110	360

2. The beginning of a no-passing zone (point "a") is that point at which the sight distance first becomes less than that specified in the above table. The end of the zone (point "b") is that point at which the sight distance again becomes greater than the minimum specified.

## G. Pavement Marking Extensions Through Intersections or Interchanges

Where road design or reduced visibility conditions make it desirable to provide control or to guide vehicles through an interchange or intersection, (such as at offset, skewed, complex multi-legged intersections or where multiple turn lanes are used) a dotted line may be used to extend markings as necessary through the intersection area (Figures 3-8a, b and c) or interchange (Figures 3-10a and 3-10b). Where a greater degree of restriction is required, continuous lane lines or channelizing lines may be continued through intersections. A frequent use for the channelizing line is to separate turning movements from through movements (Figures 3-8b and 3-8c).

## H. Lane Reduction Transitions

1. The same centerline markings should be continuous up to the point where the pavement width changes to a lesser number of through lanes. No-passing markings shall be

used to prohibit passing in the direction of the convergence, throughout the transition area. The length of transition (taper length) for a lane reduction should be computed by Table 3-1. Where no 85 percentile speed is established, the design speed or posted speed limit may be used.

2. A number of situations are possible, as illustrated in Figure 3-9, depending on which lanes must be offset or terminated and the amount of offset. One or more lane lines must be discontinued, and the remaining center and lane lines must be connected in such a way as to merge traffic into the reduced number of lanes.

3. Lane lines should be discontinued one-quarter of the distance between the Road Narrows sign (Section 2.02 D3) and the point of convergence.

4. Pavement markings at lane reduction transitions supplement the standard signs.

## I. Channelizing Line

1. The channelizing line shall be a "wide" and continuous white or yellow line.

2. The channelizing line may be used to form traffic islands where travel in the same direction is permitted on both sides. Other markings in the island area such as cross-hatching shall also be white.

3. Typical examples of channelizing line applications are shown in Figures 3-8, 3-10 and 3-11.

## J. Median Islands Formed by Pavement Markings

Two continuous double yellow lines shall be used to form narrow median islands where the islands separate travel in opposite directions. Other markings in the median island area such as crosshatching shall also be yellow.

## K. Marking of Interchange Ramps

1. Channelizing lines at exit ramps provide a neutral area which reduces the possibility of collision with the curb nose and also directs existing traffic at the proper angle for smooth divergence into the ramp (Figure 3-10). The channelizing line promotes safe and efficient merging with the through traffic at entrance ramps (Figure 3-11).

2. For exit ramps, white channelizing lines should be placed along both sides of the neutral area between the main roadway and the exit ramp lane. With a parallel deceleration lane (Figure 10a), the white-dotted extension of the right edge line should be extended from the beginning of the channelizing line

upstream for the length of the full width deceleration lane. White diagonal markings may be placed in the neutral area for special emphasis.

3. For entrance ramps, a white channelizing line should be placed along the side of the area between the ramp lane and mainline lane. With a parallel acceleration lane (Figure 3-11a), the white-dotted extension of the right edge line should be extended from the end of the channelizing line the length of the acceleration lane. With a tapered acceleration lane (Figure 3-11b), a white-dotted extension of the right edge line may be placed to extend the channelizing line, but not beyond a point where the tapered lane meets the near side of the through traffic lane.

#### **L. Approach to an Obstruction**

1. Pavement markings shall be used to guide traffic on the approach to fixed obstructions within a paved roadway. An obstruction may be so located that all traffic must keep to the right of it, or it may be between two lanes of traffic moving in the same direction. The markings in either case must be designed to guide traffic away from the obstruction. The use of channelizing lines or no-passing markings is generally effective. Obstruction approach markings for bridge supports, refuge islands, median islands, and channelization islands shall consist of a diagonal line or lines, extending from the center line or the lane line to a point about 0.5 m to the right side, or to both sides, of the approach end of the obstruction (Figure 3-12).

2. The length of the diagonal markings (taper length) should be computed by Table 3-1.

3. If traffic is required to pass only to the right of the obstruction, the marking shall consist of a no-passing marking at least twice the length of the diagonal portion determined by the applicable taper formula. Diagonal yellow markings may be placed in the triangular area as shown in Figure 3-12.

4. If traffic may pass either to right or left of the obstruction, the markings shall consist of two channelizing lines diverging from the lane line, one to either side of the obstruction for a length determined by the applicable taper formula. In advance of the point of divergence, a wide, continuous single or double white line shall be extended in place of the lane line for a distance equal to the length of the diverging lines. Additional white markings may be placed in the triangular area between the channelizing lines.

#### **M. Stop Lines**

1. Stop lines are continuous white lines, normally 300 mm wide, extending across all approach lanes. The minimum width of the line is 200 mm and the maximum is 600 mm.

2. Stop lines should be used in rural and urban areas where it is important to indicate the point, behind which vehicles are required to stop in compliance with a STOP sign, traffic signal, or railroad crossing signal.

3. Stop lines, where used, should ordinarily be placed 1 m in advance of and parallel to the nearest crosswalk line. In the absence of a marked crosswalk, the Stop line should be placed at the desired stopping point, in no case more than 10 m or less than 1 m from the nearest edge of the intersecting roadway.

4. If a stop line is used in conjunction with a STOP sign, it should ordinarily be placed in line with the STOP sign. However, if the sign cannot be located exactly where vehicles are expected to stop, the stop line should be placed at the stopping point.

#### **N. Crosswalks and Crosswalk Lines**

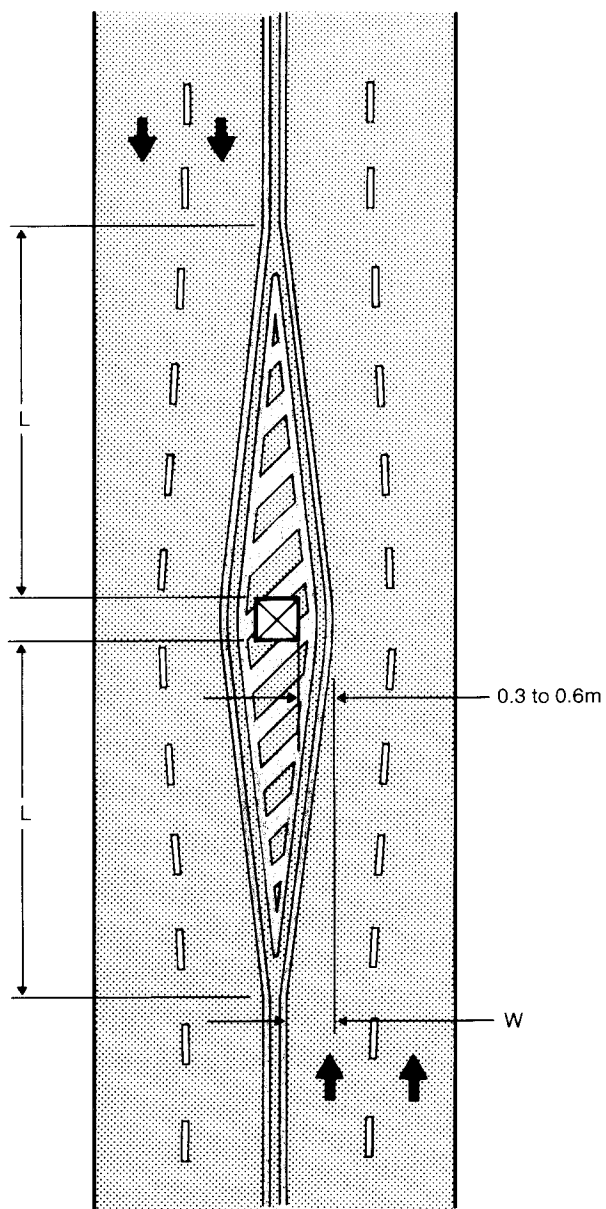
1. Crosswalk markings serve primarily to guide pedestrians in the proper paths and warn motorists of pedestrian crossing points.

2. The area of the crosswalk may be marked with white longitudinal lines at a 90° angle to the line of the crosswalk (Figure 3-13b). These lines should be approximately 500 mm wide and spaced 500 mm apart. When longitudinal lines are used to mark a crosswalk, the transverse crosswalk lines may be omitted.

3. Transverse crosswalk lines shall be continuous white lines, marking both edges of the crosswalk. These lines shall be not less than 200 mm in width and should not be spaced less than 2 m apart. Under special circumstances where a stop line is not provided, or where vehicular speeds exceed 60 km/h or where crosswalks are unexpected, it may be desirable to increase the width of the crosswalk line up to 600 mm in width.

4. Crosswalks should be marked at all intersections where there is substantial conflict between vehicle and pedestrian movements. Marked crosswalks should also be provided at other appropriate points of pedestrian concentration, such as at loading islands, midblock pedestrian crossings, or where pedestrians could not otherwise recognize the proper place to cross.

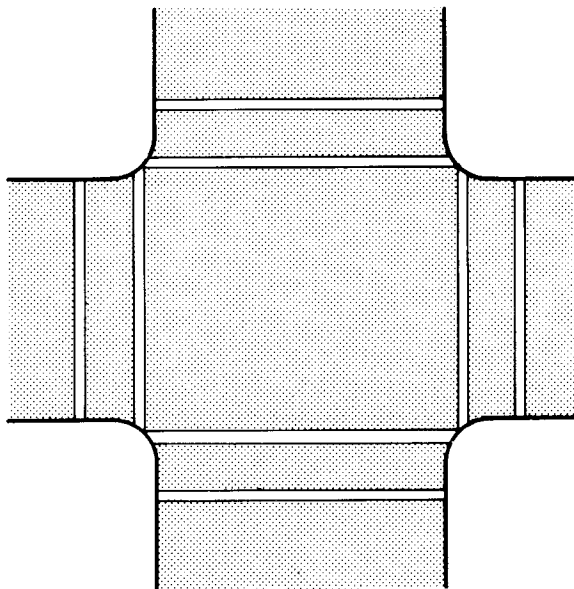
5. Crosswalk markings should not be used indiscriminately. An engineering study should be conducted before they are installed



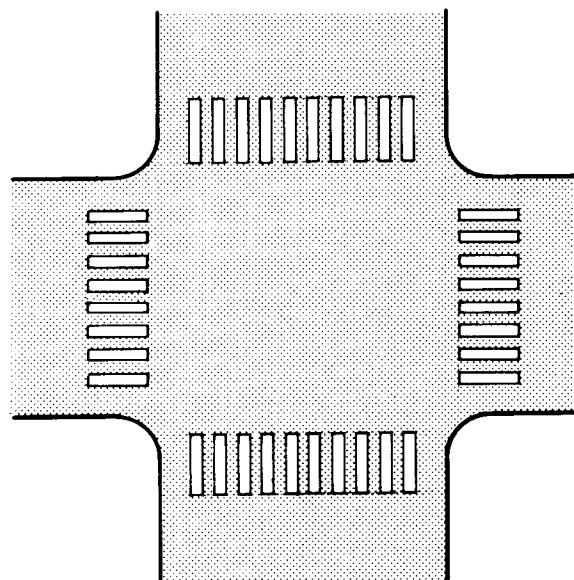
For taper length refer to Table 3-1  
 Minimum Length of  $L = 30\text{m}$  in urban areas  
 $L = 60\text{m}$  in rural areas  
 Length "L" should be extended as required by  
 sight distance conditions

**Figure 3-12**  
 Typical approach markings for  
 obstructions in the roadway.

a—Transverse crosswalk marking.



b—Crosswalk marking with longitudinal lines



**Figure 3-13**  
 Typical crosswalk markings.

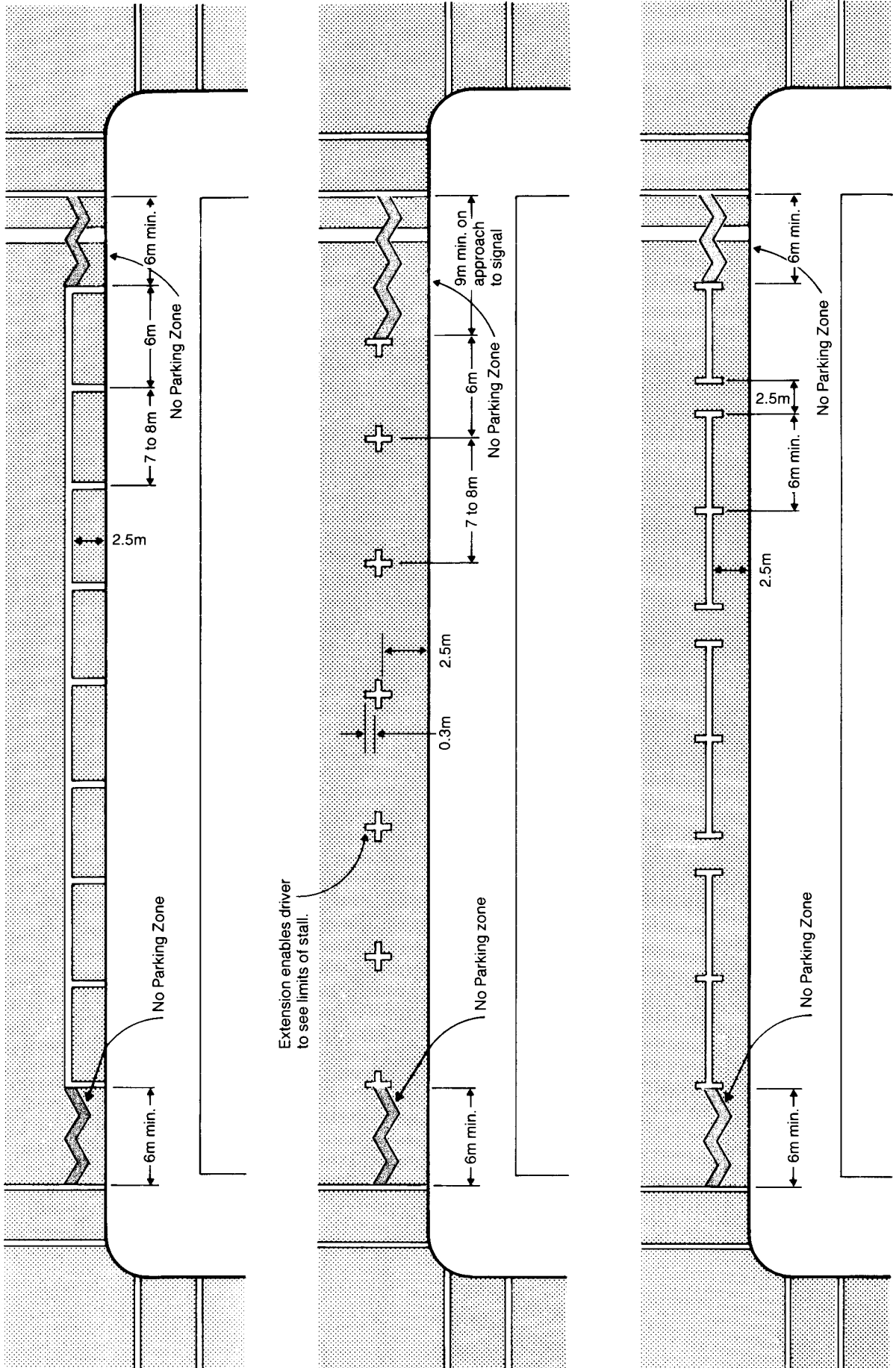


Figure 3-14  
Typical parking space limit markings.

at locations away from traffic signals or STOP signs.

6. Since nonintersectional pedestrian crossings are generally unexpected by the motorist, Pedestrian Warning signs (Section 2.02 D 11) shall be installed and adequate visibility provided by parking prohibitions.

#### **O. Parking Space Markings**

1. Parking space markings shall be white and 120 mm in width.
2. The marking of parking space limits on urban streets encourages more orderly and efficient use of parking spaces where parking turnover is substantial. It tends to prevent encroachment on fire hydrant zones, bus stops, loading zones, approaches to corners, clearance spaces for islands, and other zones where parking is prohibited. Typical parking space markings are shown in Figure 3-14.

#### **P. Pavement Word and Symbol Markings**

1. Word and symbol markings on the pavement may be used for the purpose of guiding, warning, or regulating traffic. The markings shall be white in color.
2. Symbol arrows may be used to convey either guidance or mandatory messages. Signs or markings should be repeated in advance of mandatory turn lanes when necessary to help motorists select the appropriate lane before reaching the end of the line of waiting vehicles. On expressways and high speed arterials, large arrows shall be used in advance of mandatory turn lanes when necessary to prevent entrapment and help drivers select the appropriate lane before reaching the end of the line of waiting vehicles. Large arrows should also be used to mark exit ramps to aid in discouraging wrong-way

movement by complementing the No Entry signs.

3. Large letters, symbols, and numerals should be used and should be 2.5 m or more in height. Symbol messages are generally preferable to word messages. Where speeds are low, somewhat smaller characters may be used.

4. The Stop symbol (Figure 3-15), shall not be used on the pavement unless accompanied by a stop line (Section 3.02 M) and STOP sign (Section 2.03 D1) and unless every vehicle is required to stop at all times.

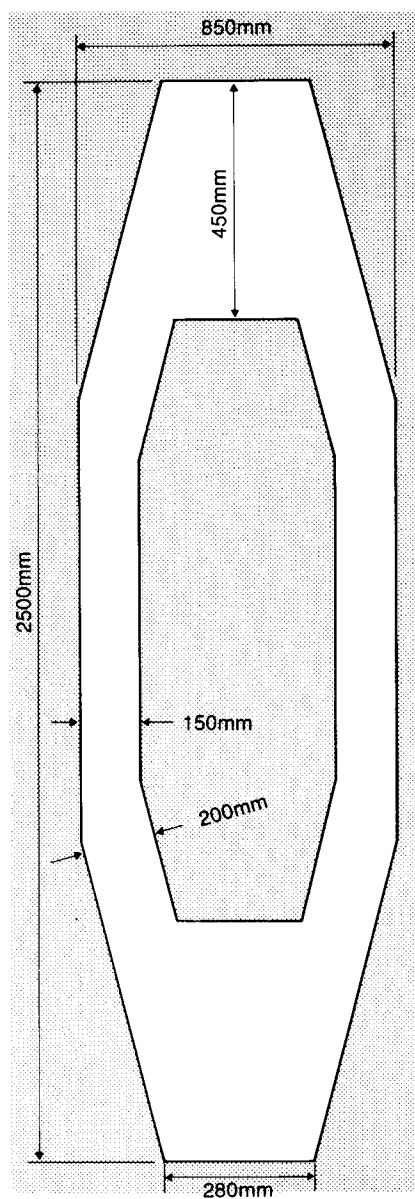
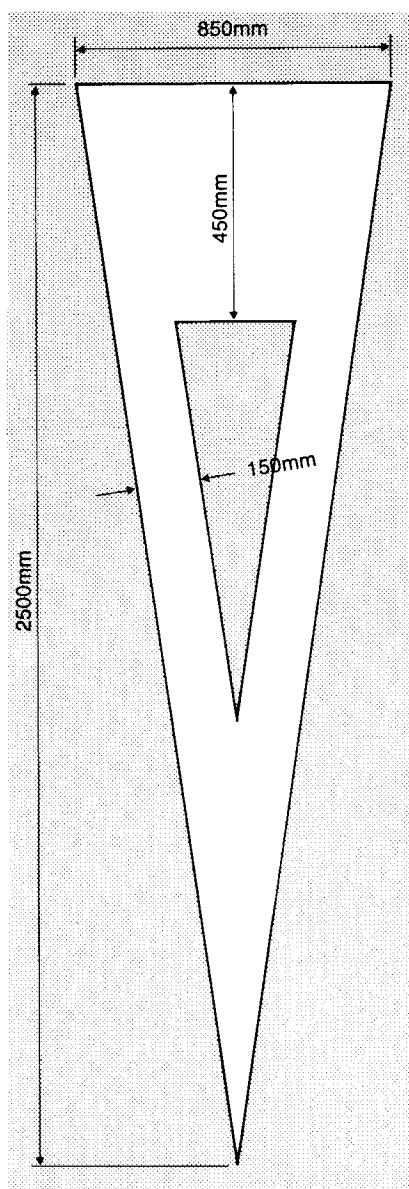
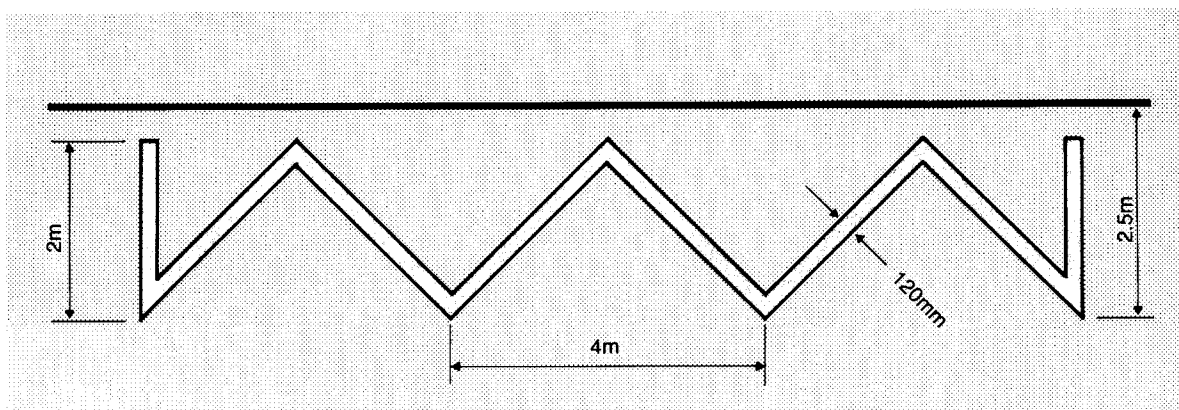
5. Pavement messages should generally be no more than one lane in width.

#### **Q. Curb Markings for Parking Restrictions**

1. Since curb markings of yellow and white are used for delineation and visibility, it is usually advisable to establish parking regulations through the installation of standard signs (Section 2.03 D31). However, when local authorities prescribe a yellow color for curb markings to be used in lieu of or supplemental to standard signs, it shall be used.
2. When signs cannot be used, the intended meaning should be stenciled on the curb.
3. A zigzag marking may be used (Figures 3-14 and 3-15).
4. Signs shall always be used with curb markings in those areas where curb markings are frequently obliterated by sand and dust.

#### **R. Typical Applications—Pavement Markings**

Typical applications, with detailed placement information, are shown in the following illustrations.



**Figure 3-15**  
**Elongated symbols.**

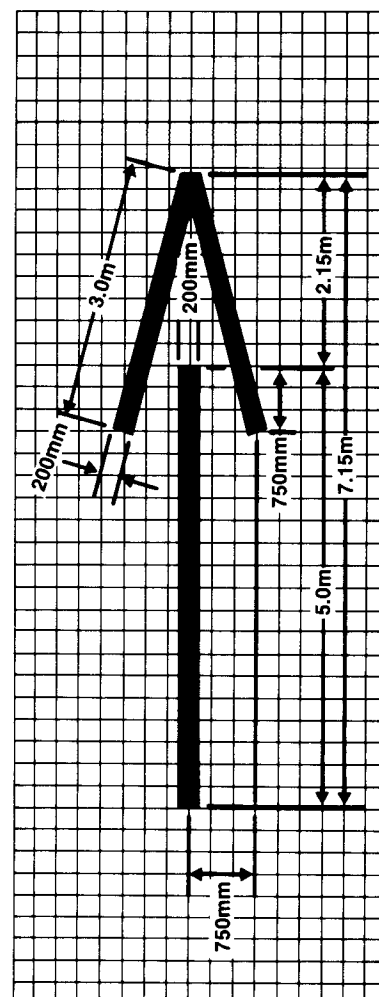
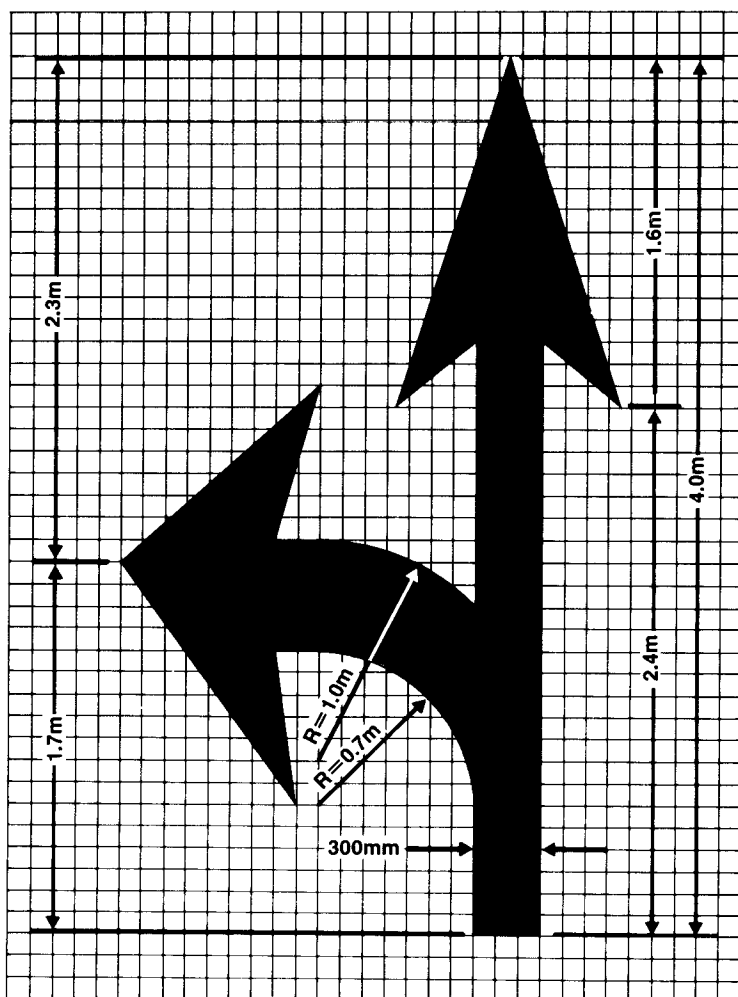
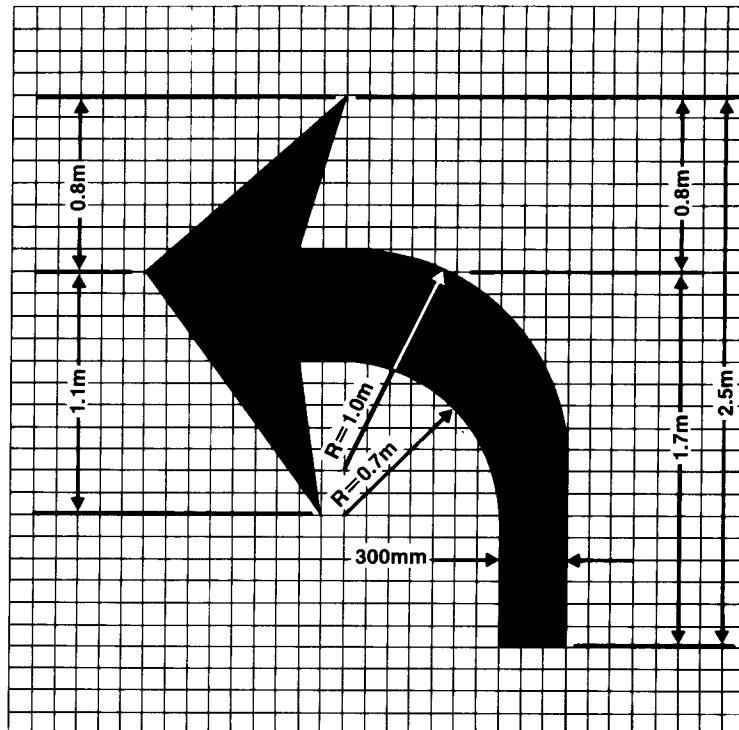
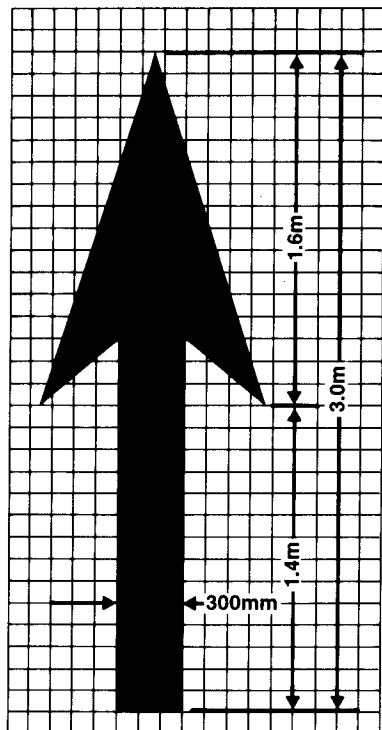


Figure 3-16  
Elongated arrows for pavement markings.

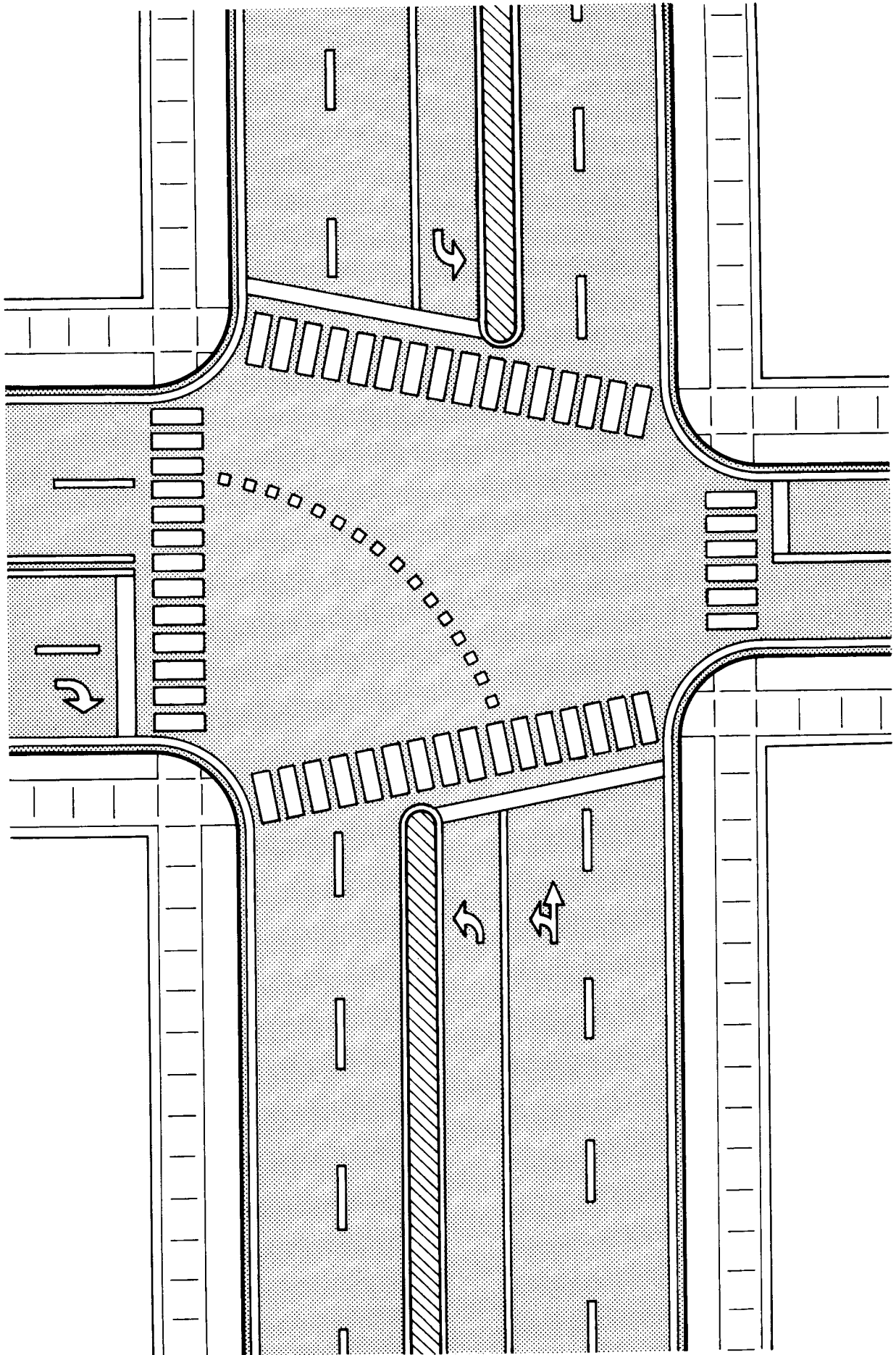
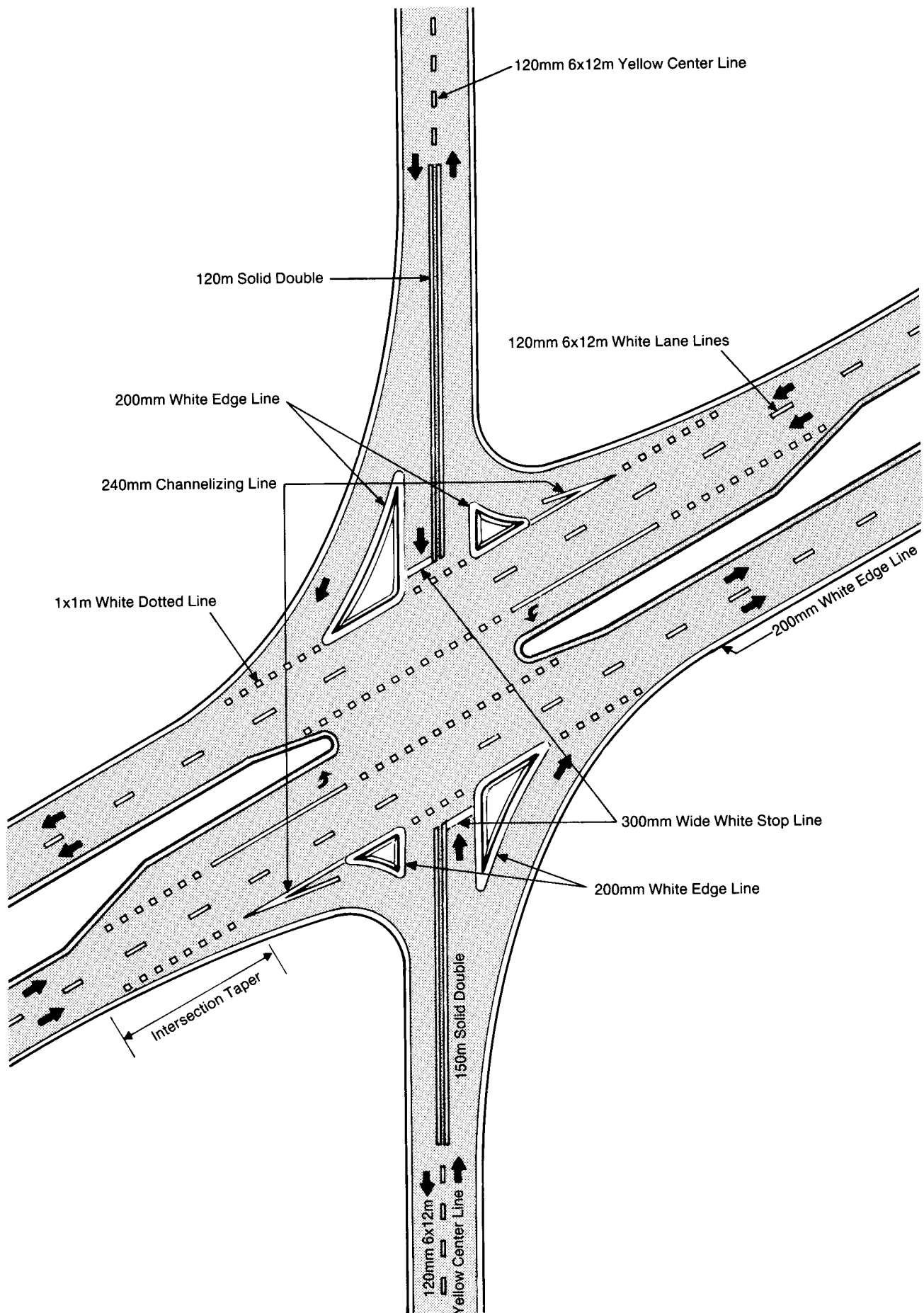


Figure 3-17  
Typical lane-use control markings.





**Figure 3-19**  
**Typical markings at a high speed rural intersection.**



### 3.03 Object Markers

#### A. Object Marker Design

Object markers are used to mark obstructions within or adjacent to the roadway. When used, these markers shall consist of an arrangement of one or more of the following designs:

1. Type 1—A marker consisting of an all yellow reflective diamond panel 450 mm in size. Nine yellow reflector units may be used in the panel. Each reflector unit shall have a dimension of approximately 75 mm mounted symmetrically on a 450 mm diamond, yellow panel. Type 1 markers may be larger if conditions warrant. (See figure 3-20a.)

2. Type 2—A striped marker consisting of a vertical rectangle approximately 300 mm by 900 mm in size with alternating black and reflectorized yellow stripes sloping downward at an angle of 45° toward the side of the obstruction on which traffic is to pass. The minimum width of the yellow stripe shall be 75 mm. A better appearance can be achieved if the black stripes are slightly wider than the yellow stripes. Type 2 object markers with stripes which begin at the upper right side and slope downward to the lower left side are to be designated as “right” object markers. (See figure 3-20b.)

3. Type 3—End of Roadway—When it is determined that markers should be placed at the end of a roadway where there is no alternate vehicular path, a marker consisting of nine red reflectors, each with a minimum dimension of approximately 75 mm, mounted symmetrically on an 450 mm red diamond panel; or an 450 mm diamond reflectorized red panel shall be used. More than one marker or a larger marker may be used at the end of the roadway where conditions warrant. The minimum mounting height of this marker shall be 1.20 m. Appropriate advance warning signs should be used. (See figure 3-20c.)

#### B. Objects in the Roadway

1. Obstructions within the roadway, shall be marked with a Type 1 or Type 2 object marker.

2. For additional emphasis, a large surface such as a bridge pier may be painted with diagonal stripes, 300 mm or more in width, similar in design to the Type 2 object marker. The alternating black and reflectorized yellow stripes shall be sloped down at an angle of 45° toward the side of the obstruction which traffic is to pass. The minimum mounting height shall be 1.20 m.

3. Appropriate signs (Section 2.03 D32) directing traffic to one or both sides of the obstruction may be used in lieu of the object marker. In addition to markings on the face of an obstruction in the roadway, warning of approach to the obstruction shall be given by appropriate pavement markings (Section 3.02 L).

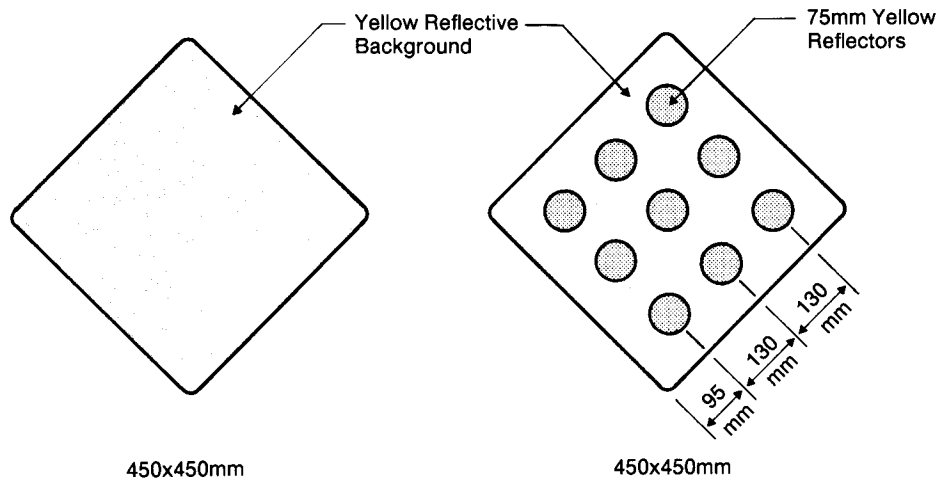
4. Where the vertical clearance of an overhead structure exceeds the maximum legal height of a vehicle by less than 0.3 m, the clearance to the nearest 0.1 m on a Regulatory sign should be clearly marked on the structure as well as on the Advance Warning sign. (See Sections 2.02 D34 and 2.03 D20).

#### C. Objects Adjacent to the Roadway

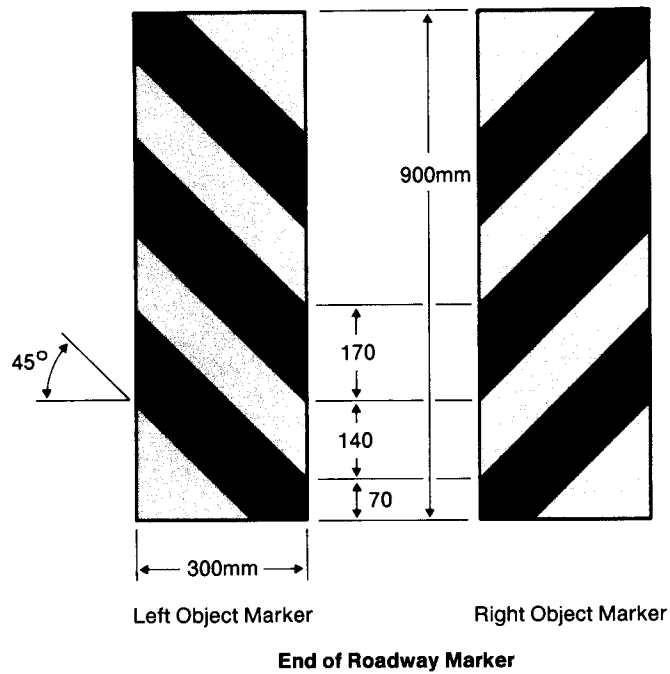
1. Objects not actually in the roadway may be so close to the edge of the road that a marker is required. These include guardrail ends, underpass piers, bridge abutments, handrails, and culvert headwalls. In some cases, a physical object may not be involved, but other roadside conditions such as narrow shoulder drop-offs, gores, small islands, and abrupt changes in the roadway alignment may make it undesirable for a driver to leave the roadway. Type 2 object markers are intended for use at such locations. The inside edge of the marker shall be in line with the inner edge of the obstruction.

2. Standard Warning signs (Section 2.02) should also be used where applicable. Typical applications of markers for roadside obstructions are shown in Figure 3-21.

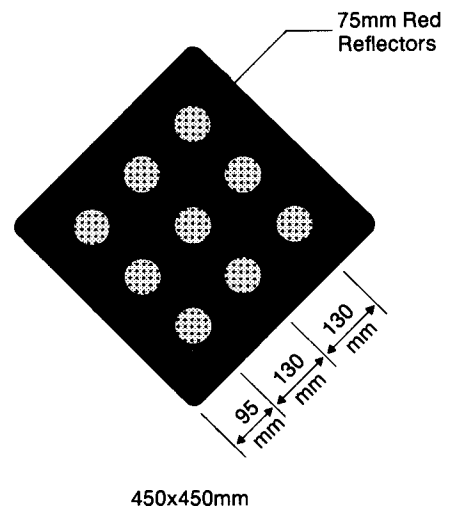
**a. Type 1**



**b. Type 2**



**c. Type 3**



**Figure 3-20  
Object Markers.**

## 3.04 Delineation

### A. Delineators

Road delineators are light retro-reflecting devices mounted in series at the side of the roadway to indicate the roadway alignment. Delineators are effective aids for night driving and considered as guidance devices rather than warning devices. Delineators may be used on long continuous sections of highway or through short stretches where there are changes in horizontal alignment, particularly where the alignment might be confusing or at pavement width transitions. An important advantage of delineators, in certain areas, is that delineators remain visible when the roadway is wet.

### B. Design

Delineators shall consist of reflector units capable of clearly reflecting light under normal atmospheric conditions from a distance of 300 m when illuminated by the upper beam of standard automobile lights. Reflective elements for delineators shall have a minimum area of approximately 100 cm<sup>2</sup>. Double delineators consist of two reflector units, one mounted above the other. Elongated reflective units of appropriate size may be used in place of the two reflectors.

### C. Curb Markings for Delineation

1. Reflectorized continuous yellow paint should be placed on the curbs of intersection islands located in the line of traffic flow where the curb serves to channel traffic to the right or to the left of the island. Reflectorized continuous white paint should be used when traffic may pass on either side of the divisional island.

2. Where the curbs of the islands become parallel to the direction of traffic flow it is not necessary to mark the curbs unless a study indicates the need for this type of delineation. Where these curbs are marked, the colors shall conform to the general principles of markings (Section 3.01 E).

3. Curbs at openings in a continuous median island need not be marked unless individual study indicates the need for this type of marking.

### D. Delineator Application

1. Delineation is intended to be a guide to the vehicle operator as to the alignment of the highway. Whatever is needed to provide that guidance in a clear and simple way should be installed.

2. The color of delineators shall, in all cases, conform to the yellow or white color of edge lines.

3. Single delineators shall be provided on the right side of expressway roadways and on at least one side of interchange ramps. These delineators may be provided on other classes of roads.

4. Single delineators may be provided on the left side of roadways and should be provided on the outside of bends on interchange ramps.

5. Where median crossovers are provided for official or emergency use on divided highways and these crossovers are to be marked, a double yellow delineator should be placed on the left side of the through roadway on the far side of the crossover for each roadway.

6. Red delineators may be used on the reverse side of any delineator whenever it would be viewed by a motorist traveling in the wrong direction on that particular ramp or roadway.

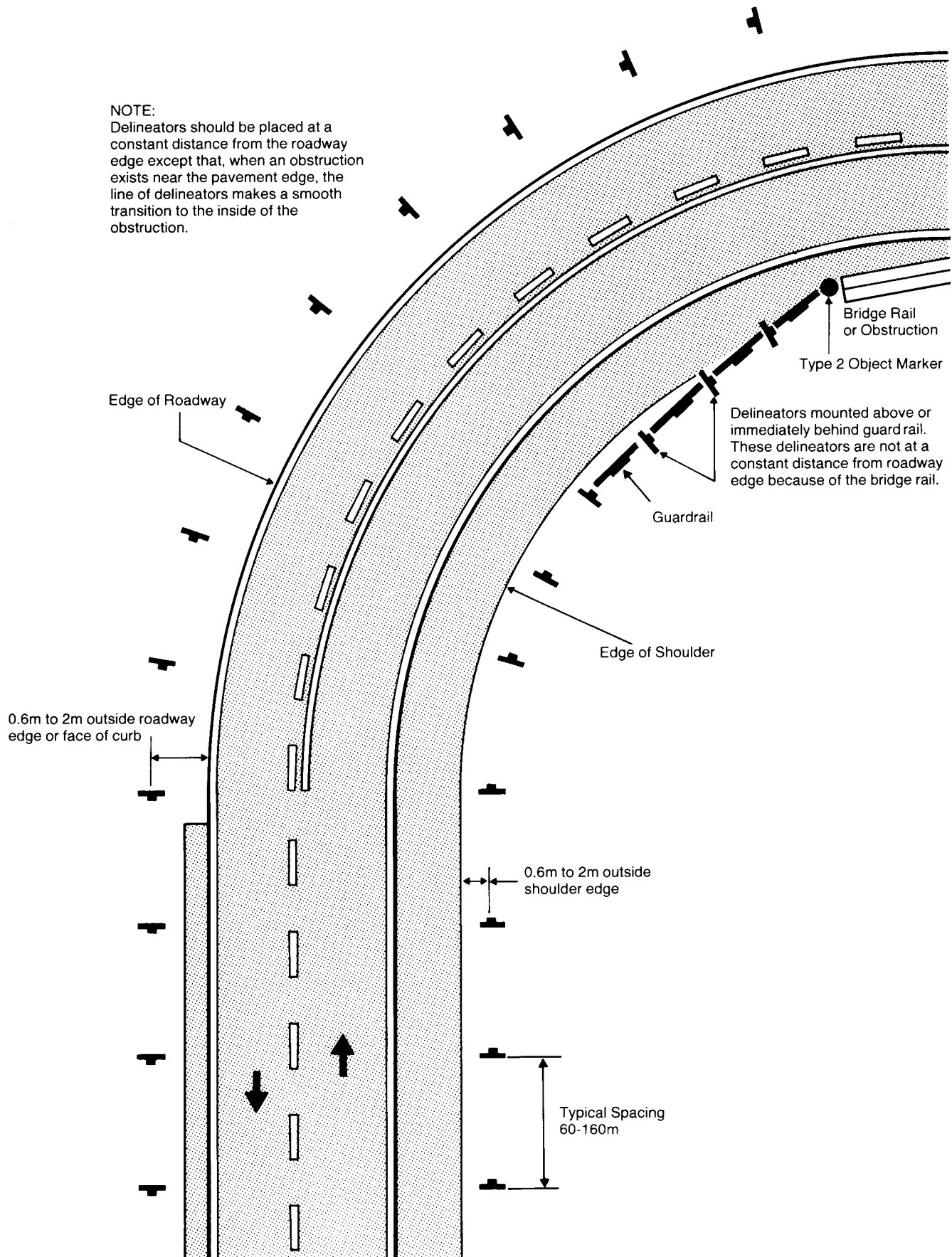
7. Delineators of the appropriate color may be used to indicate the narrowing of a pavement. The delineators should be used adjacent to the lane affected for the full length of the convergence and should be so placed and spaced to show the width reduction (Figure 3-9). Delineation is not necessary for the traffic moving in the direction of a wider pavement or on the side of the roadway where the alignment is not affected by the convergence. On a highway with continuous delineation on either or both sides, delineators should be carried through the transition and a closer spacing may be warranted.

8. Delineation is optional on sections of roadway between interchanges where fixed-source lighting is in operation.

### E. Delineator Placement and Spacing

1. Delineators, if used, shall be mounted on suitable supports so the top of the reflecting head is about 1.20 m above the near roadway edge. Delineators shall be placed not less than 1.0 m or more than 2.0 m outside the outer edge of the shoulder, or if appropriate, in the line of the guardrail. Delineators may be mounted on the guardrail at a height less than 1.2 m

2. Delineators should be placed at a constant distance from the edge of the roadway. However, where a guardrail or other obstruction intrudes into the space between the pavement edge and the extension of the line of delineators, the delineators should be in line with or inside the innermost edge of the obstruction. Typical delineator installations are shown in Figure 3-21.



**Figure 3-21**  
**Typical Delineator Installation.**

3. Normally, delineators should be spaced 60 m to 160 m. When normal uniform spacing is interrupted by driveways, crossroads, or similar interruptions delineators falling within such areas may be moved in either direction, a distance not exceeding one-quarter of the normal spacing. Delineators still falling within such areas should be eliminated. On expressways a normal delineator spacing is 100 m.

4. Double or vertically elongated delineators should be installed at 30 m intervals along acceleration and deceleration lanes.

5. Spacing should be adjusted on approaches and throughout horizontal bends so several delineators are always visible to the driver. Table 3-2 shows suggested maximum spacing for delineators at bends.

**Table 3-2**

**Suggested Maximum Spacing for Highway Delineators on Bends.**

<b>Radius of Bend (R) (meters)</b>	<b>Spacing on Bend (S) (meters)</b>
15	6
30	7.5
45	9
60	10.5
75	12
90	13.5
120	16.5
150	19.5
180	21
210	22.5
240	24
270	25.5
300	27

Spacing for radii not shown may be interpolated from table. The minimum spacing should be 6 m. The spacing of the first delineator on a tangent adjacent to a bend should be 2 S, the second 3 S, and the third 6 S but not to exceed 100 m.



### 3.05 Barricades and Channelizing Devices

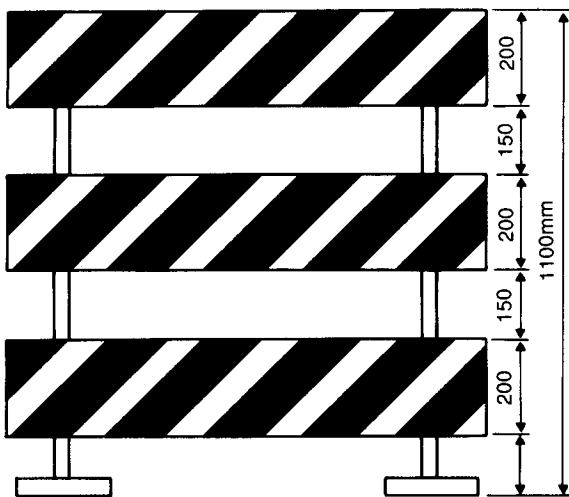
#### A. Barricades

Red and white barricades are to warn and alert drivers of the terminus of a road, street, or highway in other than construction or maintenance areas. The barricades are to meet the design criteria of Section 5.03 E for a Type II barricade, except the colors of the stripes shall be reflectorized white and reflectorized red. These devices may be used to mark any of the following type locations:

1. Roadway ends in a dead end or cul-de-sac with no outlet.
2. A ramp or lane closed for operational purposes.
3. The permanent or semi-permanent closure or termination of a roadway.

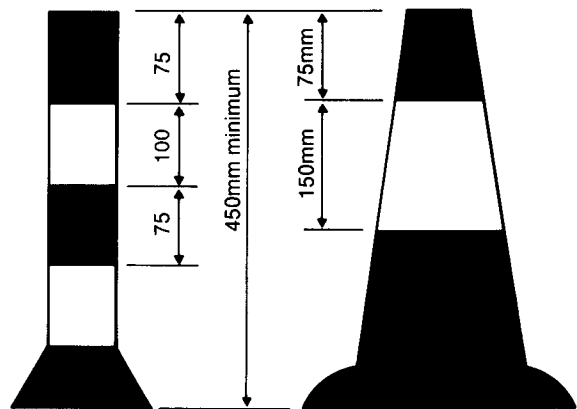
#### B. Channelizing Devices

1. Traffic cones and tubular markers are sometimes used outside of construction and maintenance areas for general traffic control purposes. Such uses include adding emphasis to channelizing lines or islands.
2. These devices shall be a minimum of 450 mm in height and made of materials to withstand impact without damage to the devices or vehicles. Large size devices should be used wherever more conspicuous guidance is needed.
3. The color of cones and tube markers used outside construction and maintenance areas shall be the same as the pavement marking these markers are supplementing or substituting. These markers should be kept clean and bright for maximum target value. For nighttime use, the markers shall be reflectorized.



Standard Barricade—Type II

(See Figure 5-4 for details)



Tubular  
Marker

Traffic  
Cone

(See pages 5-16, 17, 18 for details)

**Figure 3-22**  
**Barricades and Channelizing Devices.**



## 3.06 Raised Pavement Markers

### A. General Principles

1. Raised pavement markers, generally less than 25 mm in height, may be used for pavement marking purposes. These markers may be round, square or rectangular in shape with dimensions as approved by the Ministry of Communications.
2. There are several different types of markers. The characteristics of the particular types are related to their functional applications.
3. These markers may be used as a supplement to or a substitute for other types of marking materials such as paint or plastic.
4. The color shall conform to the color of the markings these raised pavement markers supplement or the markings for which they are substituted.
5. Raised retro-reflective pavement markers may be used to supplement other types of pavement markings or in combination with nonreflectorized raised pavement markers as a substitute for other types of materials. These reflectorized markers may be used to provide improved night visibility especially during adverse weather conditions such as rain, blowing sand, or dust.

### B. Functional Applications

The determination of the normal spacing of the raised markers should be established in rela-

tion to the existing pattern of segments and gaps used with broken lines. This will avoid conflict or overlap. Figure 3-21 illustrates recommended spacings for reflectorized and nonreflectorized raised pavement markers.

1. Generally, these markers are placed in alternate gaps to supplement a broken line and at a reduced spacing to supplement a continuous line. In some cases each stripe segment may be supplemented by a raised pavement marker and each gap may contain a raised pavement marker.

2. For special situations, closer spacing may be used. This reduced spacing may be used if there are special hazardous locations. For example, a reduced spacing may be desirable at sharp bends, approaches to problem intersections, locations where there is a predominance of bad weather (such as sand storms or blowing dust), at high traffic volume locations, or through transition areas where the number of lanes is reduced.

3. Markers placed adjacent to a painted line shall be offset by 3 cm.

4. The spacing for raised pavement markers when used as a substitute for broken or continuous lines can be determined from Figure 3-23.

5. Edge line markers are set on the roadway side of the line.

Type of Lines	RPM's Used to Supplement Other Markings	RPM's Used as a Substitute for Other Types of Material
Broken Lines		
Single Solid Lines		
Double Solid Lines		

$N$  = Generally equal to length of one gap plus one segment

$$a = \frac{\text{Length of one segment}}{3}$$

= Paint or plastic pavement marking

$$d = \frac{N_m}{10}$$

◆ = Reflectorized raised pavement marker

● = Nonreflectorized raised pavement marker

RPM Spacing in gore areas = 1.0m

**Figure 3-23**  
Recommended spacing for raised pavement markers.

## Part 4. Signals

### 4.01 General Considerations

#### A. Standardization, Design and Application

1. Standardization of the design, installation, and operation of traffic signals becomes increasingly important as more of these devices are put into use. Traffic reacts more safely and quickly to uniform traffic signals than to signals varying widely in design and operation.

2. In addition to standards and criteria for design, installation and operation, this Manual contains a number of required and recommended procedures and techniques. These include methods of analysis and design, operational procedures, and examples of design and installation. The examples are provided as guides. The design, installation, and operation of traffic signals shall conform to the standards and criteria given in this Manual.

#### B. Types

The standards for the following traffic signals are given in this Part.

1. Traffic control signals (stop-and-go lights) including pedestrian signal indications. (The terms, traffic signal and signal, are sometimes used for purposes of simplification to mean traffic control signal.)

2. Beacons (flashers), but not barricade warning lights which are discussed in Part 5.

#### C. Good and Bad Effects of Traffic Control Signals

1. When the amount of traffic entering an intersection is heavy, a traffic control signal may have the following good effect:

- a. It may reduce the number of some types of accidents, particularly right-angle accidents.
- b. It will result in more orderly movement of traffic through the intersection.
- c. It will give drivers and pedestrians safer opportunities to cross a street.
- d. If properly designed and operated, it may increase the number of vehicles safely going through the intersection.
- e. Under favorable conditions, the operation of adjacent signals or groups of signals may be coordinated to permit the continuous or nearly continuous movement of traffic along a street or on a street grid.

2. However, a traffic control signal poorly designed, operated, or maintained, or a sig-

nal placed at an intersection with low traffic volume will have bad effects:

- a. It will cause unnecessary delay to traffic.
  - b. It may cause an increase in accidents (particularly rear-end accidents).
  - c. It may cause some drivers to disobey the signal indications or take another route to avoid the traffic control signal.
3. The installation of traffic control signals should be considered only if the good effects outweigh the bad effects.

#### D. Area of Control

A traffic control signal shall control traffic only at the intersection or midblock location at which it is placed.

#### E. Pretimed and Traffic-Actuated Signal Types

1. Traffic control signals at a specific intersection may be either pretimed or traffic-actuated.

a. Pretimed Signal—A type of traffic control signal in which the cycle, phasing, intervals, and indications are predetermined and do not vary. They are repeated until changed manually or by a control mechanism such as a clock or master controller.

b. Traffic-Actuated Signal—A type of traffic control signal in which the length of most intervals and the cycle, and in some types the sequence of phasing, are varied by the demands of traffic.

2. The timing, intervals, sequence, and phasing of pretimed traffic control signals are generally predetermined but can be changed by time clock or other automatic control. In traffic-actuated equipment, these features are constantly varied by traffic demand.

3. Both types of control may be included in a system composed of traffic signal controllers at several intersections whose operation is coordinated for efficient traffic flow. The critical features of the position, visibility, and permissible sequence of signal indications are the same for all types of traffic control signals.

#### F. Portable Traffic Control Signals

1. A portable traffic control signal shall be used only when a signal is needed for a short

time emergency situation or for a work area. It shall be used only when an engineering study shows a signal is required. A portable traffic control signal shall not be used if a flagman or police officer can economically and safely direct traffic. A portable traffic control signal shall not be used at a school crossing.

2. When used, a portable traffic control signal shall meet all of the physical, display, and operational requirements in this Part. Signal Ahead signs (W 15) shall always be used on the approaches to a portable traffic control signal.

## 4.02 Signal Use Criteria

### A. Factors to be Considered

1. Several factors should be considered before a decision is made whether or not to install a traffic control signal:

- a. The number of vehicles entering the intersection and major turning movements by these vehicles.
- b. The number of pedestrians crossing each approach to the intersection.
- c. The length of time traffic is congested at the proposed traffic control signal location.
- d. The number and type of accidents at the location.
- e. Physical features such as sight distances, grade, or width of street area.
- f. The interruption to the smooth flow of traffic a traffic control signal would cause.
- g. The possibility of using a less restrictive control device.

2. Traffic control signals shall not be installed unless one or more of the signal criteria in the Manual are met. These criteria shall be applied whether a pretimed or a traffic-actuated signal is being considered.

3. If a decision is made to install a traffic control signal, future traffic needs should be considered in its design and installation.

4. Traffic studies of existing signalized intersections shall be made at reasonable intervals. If a study indicates the criteria for existing traffic control signals are no longer met, the operation of these signals shall be discontinued.

### B. Engineering Data Requirements

1. A traffic engineering study shall be made of an intersection or other problem location before a decision is made to (or not to) install a traffic control signal. The study shall obtain at least the following data:

- a. On a day representative of average traffic volumes, the number of vehicles entering the intersection in each hour from each approach during the 16 consecutive hours of greatest total traffic. The vehicles turning right, going straight through and turning left should be separately recorded. (Typical traffic count forms for this purpose are illustrated in Figures 4-1 and 4-2.)
- b. The number of pedestrians crossing the

intersection in each crosswalk during the same hours the vehicles are counted. (A typical pedestrian count form is illustrated in Figure 4-3.)

c. A diagram of the intersection for at least 50 m in each direction on each approach. (See Figure 4-4 for the information to be shown on this condition diagram.)

d. A collision diagram showing the accidents during the last 12-month period for which accident data is available. (See Figure 4-5 for the data to be shown on this diagram.)

e. The speed of vehicles on the intersection approaches not controlled by STOP signs. From this data the speed at or below which 85 percent of the vehicles were being driven can be calculated. (A form for recording vehicle speeds and calculating the 85 percentile speed is shown in Figure 4-6.)

2. Data on the types of vehicles entering the intersection is not required but may be helpful in evaluating the problems at some intersections. Such a vehicle classification count should be made during two separate periods, each of 2 hours duration, when traffic volumes are highest. Preferably one period should be in the morning and the other in the afternoon or evening. However, the hours when traffic volumes are greatest will be the determining factor. Each vehicle should be recorded as a heavy truck, a passenger car or light truck, or a bus. The number of each of these three classes of vehicles entering the intersection during each 15-minute period of each of the 2-hour periods should be recorded. (The form shown in Figure 4-1 can be used for this purpose by subdividing each group of three boxes and recording a class of vehicle in each subdivision.)

3. When planning a signal installation, it is necessary to provide adequate roadway width to accommodate the volume of vehicles on each approach. Frequently, this can be accomplished by prohibiting parking for a sufficient distance back from the intersection to provide a right-turn lane or by widening the roadway. On each approach, at least two lanes for moving traffic, one for through traffic, and one for right or left turn traffic, should be provided unless it is physically impossible to do so.



### Traffic Survey Vehicle Volume Count Tally Sheet

Date \_\_\_\_\_ Day \_\_\_\_\_ Time \_\_\_\_\_ to \_\_\_\_\_

Location: Adm. Division \_\_\_\_\_

Rural \_\_\_\_\_ City \_\_\_\_\_

Intersection \_\_\_\_\_ and \_\_\_\_\_

Weather \_\_\_\_\_

Road Condition \_\_\_\_\_ Observers \_\_\_\_\_

---

From \_\_\_\_\_ On \_\_\_\_\_

From \_\_\_\_\_ On \_\_\_\_\_

Right

Straight

Left

Left

Straight

Right

Left

Right

Straight

Left

Left

Straight

Right

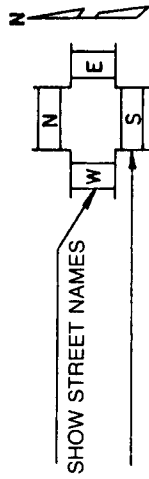
From \_\_\_\_\_ On \_\_\_\_\_

From \_\_\_\_\_ On \_\_\_\_\_

**Figure 4-1**  
Vehicle volume count field data form.

Vehicle and Pedestrian Volume Summary

LOCATION	
DAY & DATE	
WEATHER	
BY	



- ☐ ALL VEHICLES  
☐ TRUCKS & BUSES ONLY

NAME OF STREETS	FROM NORTH			FROM SOUTH			FROM EAST			FROM WEST			TOTALS			PEDESTRIANS					
	L	A	R	L	A	R	L	A	R	L	A	R	L	A	R	N	S	E	W	N-S	E-W
	TOT			TOT			TOT			TOT			TOT								
MID- - 1 A.M.																					
NITE																					
1 A.M. - 2 A.M.																					
2 A.M. - 3 A.M.																					
3 A.M. - 4 A.M.																					
4 A.M. - 5 A.M.																					
5 A.M. - 6 A.M.																					
6 A.M. - 7 A.M.																					
7 A.M. - 8 A.M.																					
8 A.M. - 9 A.M.																					
9 A.M. - 10 A.M.																					
10 A.M. - 11 A.M.																					
11 A.M. - NOON																					
NOON - 1 P.M.																					
1 P.M. - 2 P.M.																					
2 P.M. - 3 P.M.																					
3 P.M. - 4 P.M.																					
4 P.M. - 5 P.M.																					
5 P.M. - 6 P.M.																					
6 P.M. - 7 P.M.																					
7 P.M. - 8 P.M.																					
8 P.M. - 9 P.M.																					
9 P.M. - 10 P.M.																					
10 P.M. - 11 P.M.																					
11 P.M. - MID-NITE																					
TOTAL																					
TOTAL																					

Figure 4-2  
Traffic volume summary form.



# Crosswalk Field Sheet Pedestrian Count

Time \_\_\_\_\_ To \_\_\_\_\_

Date \_\_\_\_\_

Observer \_\_\_\_\_

Children		
Adults	↓	↑

(Street Name) \_\_\_\_\_

(Street Name) \_\_\_\_\_

**Figure 4-3**  
**Pedestrian count field data form.**





## Collision Diagram

Intersection MAKKAH ROAD and MAAZAR ROAD  
 Period 1 YEAR from 1 MUHARRAM 1398 to 30 DHU AL-HIJJAH 1398  
 City RIYADH Prepared by H#B

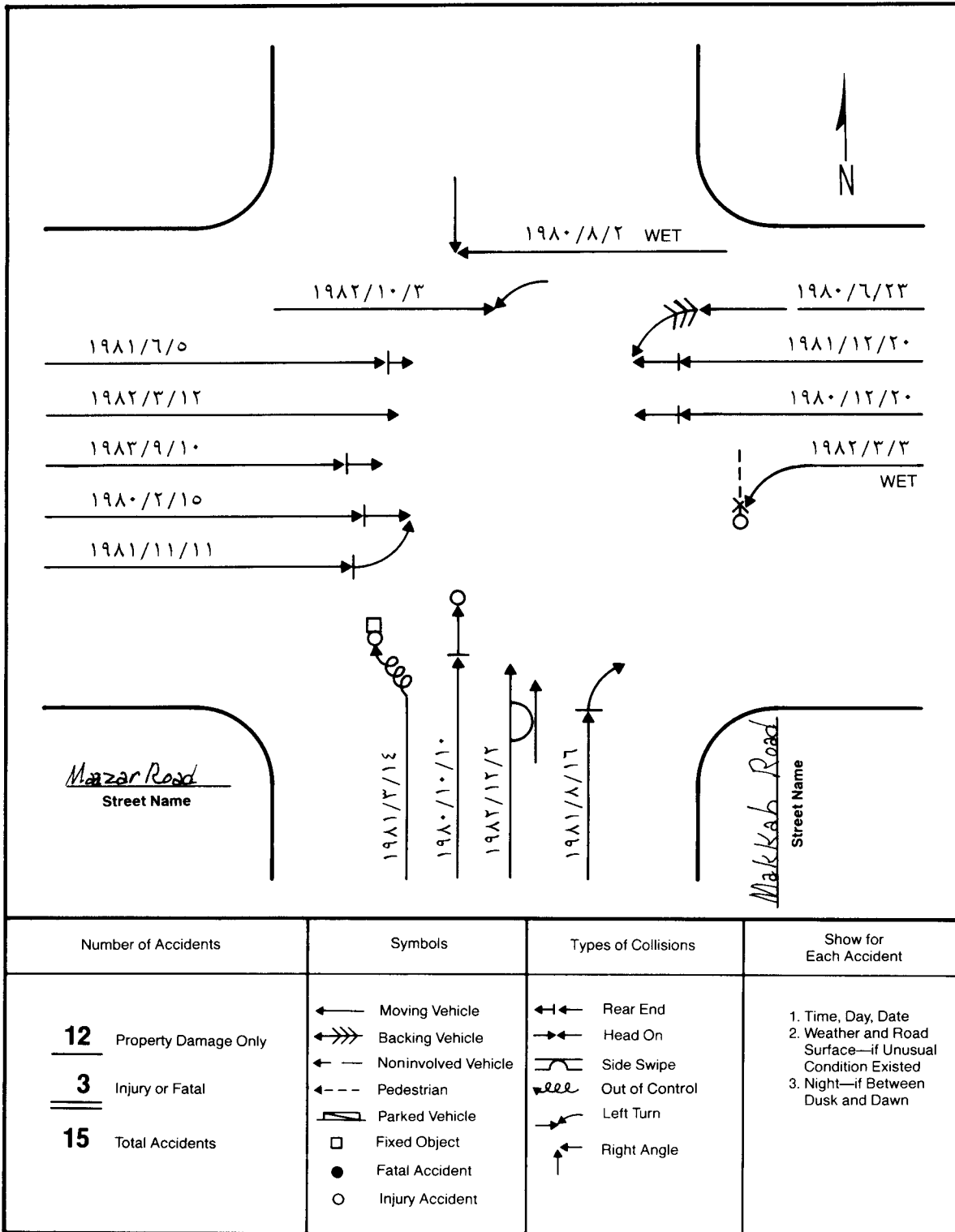


Figure 4-5

# Vehicle Speed Study Field Data Form

Description of Location

### Figure 4-6

4. Information obtained from the traffic engineering studies should be compared with the criteria set forth below to determine if signals are warranted.

#### C. Criterion 1—Minimum Vehicular Volume

1. The desirability of a traffic control signal may be indicated principally by the volume of traffic on the intersecting streets. This criterion is met under the following conditions:

- When large traffic volumes exist for **each** hour of **any** 8 hours of an average day.
- When the volumes of traffic are at least equal to those in Table 4-1.
- An “average day” is any day, (other than a Friday) when the traffic volumes entering the intersection are representative of those normally and repeatedly found at that location.
- The volumes given in the last two columns of Table 4-1 must occur during the same hours.
- The higher volume minor street approach (fourth column, Table 4-1) may be one of the approaches during some of the 8 hours and the opposite approach during other hours.

**Table 4-1**

**Minimum Vehicular Volumes for Criterion 1**

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)	Vehicles per hour on higher volume minor-street approach (one direction only)
Major Street	Minor Street		
1	1	500	150
2 or more	1	600	150
2 or more	2 or more	600	200
1	2 or more	500	200

2. This criterion is also met if the traffic volumes at the intersection are 70 percent or more of those shown in Table 4-1 when

- the speed of 15 percent of the traffic on the main street is 65 km/h or more, whether the intersection is in an urban area or rural area or
- the intersection is in an area with frequent buildings (a built-up area) in a city or village having a population of less than 10,000, and it is not near a larger city or village.

3. Figure 4-7 is an example of a traffic count made to determine if the minimum vehicular volumes for Criterion 1 were met. The data, in the shaded columns show both the side street approach volumes and the main street volumes met the criteria.

#### D. Criterion 2—Interruption of Continuous Traffic

1. The desirability of a traffic control signal may be indicated by large numbers of vehicles on the major street. This may result in unreasonable delay and hazard to traffic on the intersecting street. This criterion is met under the following conditions:

- When large traffic volumes exist on the major street for **each** hour of **any** 8 hours of an average day.
- The volumes of traffic are at least equal to those in Table 4-2.
- An “average day” is any day (other than a Friday) when the traffic volumes entering the intersection are representative of those normally and repeatedly found at that location.
- The volumes given in the last two columns of Table 4-2 must occur during the same hours.
- The higher volume minor street approach (fourth column, Table 4-2) may be one of the approaches during some of the 8 hours, and the opposite approach during other hours.

2. This criterion is also met if the traffic volumes at the intersection are 70 percent or more of those shown in Table 4-2 when

- the speed of 15 percent of the traffic on the main street is 65 km/h or more, whether the intersection is in an urban area or a rural area, or

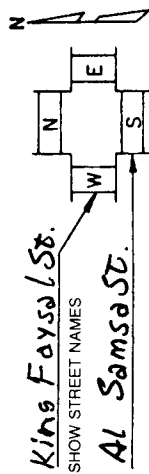
**Table 4-2**

**Minimum Vehicular Volumes for Criterion 2**

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)	Vehicles per hour on higher volume minor-street approach (one direction only)
Major Street	Minor Street		
1	1	750	75
2 or more	1	900	75
2 or more	2 or more	900	100
1	2 or more	750	100

Vehicle and Pedestrian Volume Summary

CITY	ABHA
INTERSECTION	King Faysal and Al Samsa St.
DAY & DATE	Attalat - 10 Rajab 1398
WEATHER	Fair & Hot



☒ ALL VEHICLES  
☐ TRUCKS & BUSES ONLY

85 PERCENTILE SPEED > 65 kmh YES ☐ NO ☒  
POPULATION < 10,000 ☐ ☒  
WARRANT SATISFIED NONE ☐ 1 ☒ 2 ☐ 3 OTHERS ☐

NAME OF STREETS	AL Samsa St. FROM NORTH				AL Samsa St. FROM SOUTH				King Fayzal St. FROM EAST				King Fayzal St. FROM WEST				TOTALS			PEDESTRIANS												
	L	A	R	TOT	L	A	R	TOT	L	A	R	TOT	L	A	R	TOT	N-S	E-W	ALL	N	S	E	W	N-S	E-W	TOTAL						
MID- NITE																																
1 A.M. - 2 A.M.																																
2 A.M. - 3 A.M.																																
3 A.M. - 4 A.M.																																
4 A.M. - 5 A.M.																																
5 A.M. - 6 A.M.																																
6 A.M. - 7 A.M.	67	194	144	405	17	58	20	95	12	607	11	630	19	332	61	412	500	1042	1542													
7 A.M. - 8 A.M.	95	412	158	665	52	150	62	264	15	1030	34	1079	54	637	147	838	929	1917	2846													
8 A.M. - 9 A.M.	61	219	70	350	60	157	58	275	21	546	33	600	108	577	115	800	625	1400	2025													
9 A.M.-10 A.M.	61	155	72	288	42	159	42	243	20	475	42	537	108	491	79	678	531	1215	1746													
10 A.M.-11 A.M.	67	148	64	279	61	147	42	250	20	460	38	518	112	522	74	708	529	1226	1755													
11 A.M. - NOON	55	179	96	330	67	228	55	350	23	580	48	651	163	728	87	978	680	1629	2309													
NOON - 1 P.M.	55	201	132	388	63	209	71	343	23	645	47	715	121	674	93	888	731	1603	2334													
1 P.M. - 2 P.M.	65	156	111	332	54	178	41	273	23	596	45	664	98	538	65	701	605	1365	1970													
2 P.M. - 3 P.M.	66	215	108	389	50	197	13	260	24	560	67	651	111	546	91	748	649	1399	2048													
3 P.M. - 4 P.M.	65	258	54	377	94	385	50	529	18	606	63	687	161	860	127	1148	906	1835	2741													
4 P.M. - 5 P.M.	53	247	67	367	90	409	32	531	18	676	108	802	277	1093	113	1483	898	2285	3183													
5 P.M. - 6 P.M.	45	214	81	340	75	368	42	465	24	685	79	788	182	717	89	988	825	1776	2601													
6 P.M. - 7 P.M.	91	213	94	398	63	238	40	341	28	547	64	639	125	600	59	784	739	1423	2162													
7 P.M. - 8 P.M.	87	214	77	378	42	174	41	257	32	520	58	610	99	471	68	638	635	1248	1883													
8 P.M. - 9 P.M.	41	137	82	260	46	137	21	204	29	503	47	579	92	461	56	609	464	1188	1652													
9 P.M.-10 P.M.	39	75	72	186	48	136	22	206	24	369	36	429	37	229	40	306	392	735	1127													
10 P.M. -11 P.M.																																
11 P.M. - MID-NITE																																
TOTAL	1013	3237	1482	5732	924	3330	652	4906	354	9405	820	10579	1867	9476	1364	12707	10638	23286	33924													
NO OF LANES	2				2				2				2				2				2				2				2			

Figure 4-7  
Example of a test for criterion 1, minimum vehicular volume.

- b. the intersection is in an area with frequent buildings (a built-up area) in a city or village having a population of less than 10,000, and it is not near a larger city or village.
- 3. A traffic control signal shall not be installed under this criterion if its installation would seriously disrupt the flow of traffic in an existing or potential progressive signal system. (See Glossary for meaning of "progressive signal system.")
- 4. Figure 4-8 is an example of a traffic count made to determine if the minimum vehicular volumes for Criterion 2 were met.

#### E. Criterion 3—Minimum Pedestrian Volume

- 1. A traffic control signal may be considered because many pedestrians wish to cross a busy street. Large volumes of traffic on a street may not permit pedestrians sufficient time to cross safely. This criterion may be met under the following conditions:
  - a. When large vehicle and pedestrian volumes exist for **each** hour of **any** 8 hours of an average day.
  - b. The vehicle and pedestrian volumes are at least equal to those in Table 4-3.
  - c. An "average day" is any day (other than a Friday) when the traffic volumes entering the intersection are representative of those normally and repeatedly found at that location.
  - d. The volumes given in the last two columns of Table 4-3 must occur during the same hours.

**Table 4-3**

**Minimum Vehicular and Pedestrian Volumes for Criterion 3**

Type of Roadway	Vehicles per hour on major street (total of both approaches)	Pedestrians per hour crossing the major street on the crosswalk having the greatest number of pedestrians
No pedestrian refuge island in the street	600	150
Having a raised island at least 1.25 m wide in the middle of the approach	1,000	150

- e. One of the crosswalks may carry the greatest pedestrian volumes during some of the 8 hours and the other crosswalk during other hours.
- 2. This criterion is also met if the vehicular or pedestrian traffic volumes at the intersection are 70 percent or more of those shown in Table 4-3 when
  - a. the speed of 15 percent of the traffic on the major street is 65 km/h or more, or
  - b. the intersection is in an area with frequent buildings (a built-up area) in a city or village having a population of less than 10,000, and it is not near a larger city or village.

- 3. Traffic control signals installed when this criterion is satisfied shall be equipped with pedestrian signal indications.
- 4. If a signal is installed at an intersection more than 600 m from the nearest signal, it shall be traffic actuated. Also, it shall have pedestrian pushbuttons at each end of each crosswalk across the major street.
- 5. Traffic control signals may be installed when this criterion is met at locations between intersections, provided the crosswalk is 50 or more meters from another crosswalk or intersection. If the signal is within a progressive signal system, it shall be coordinated with that system. In such cases, curbside parking shall be prohibited for at least 30 m before the crosswalk and 10 m beyond it.

#### F. Criterion 4—School Crossing

- 1. When children wish to cross a street, adequate gaps are needed between vehicles for the children to cross safely. (See Section 6.01 for an explanation of the term "adequate gap".) However, adequate gaps may not occur frequently enough. This criterion is satisfied when the number of adequate gaps is less than the number of minutes in the time period of the day during which children wish to cross. Generally, this period should not be less than 15 minutes.
- 2. When traffic control signals are installed where this criterion but no other criterion is satisfied, the following actions are also required:
  - a. Pedestrian signal indications shall be provided for each crosswalk which has been designated for school children. Pedestrian signal indications may be provided for other crosswalks.
  - b. A school crossing signal at an intersection shall be fully traffic actuated. Signals in a progressive signal system may have

# Vehicle and Pedestrian Volume Summary

**Jeddah** **INTERSECTION** **AL Hamra St. and Madinah Rd.**

DAY & DATE **AL-Had. 8 Safar 1398**

WEATHER **P-C and Hot**

☒ ALL VEHICLES ☐ TRUCKS & BUSES ONLY

**AL Hamra St.** **Madinah Rd.**

SHOW STREET NAMES  
**Madinah Rd.**

85 PERCENTILE SPEED > 65 kmh YES ☐ NO ☐

POPULATION < 10,000 ☒

WARRANT SATISFIED NONE 1 2 3 OTHERS ☐ ☐ ☐ ☐

NAME OF STREETS	Madinah Rd. FROM NORTH				Madinah Rd. FROM SOUTH				AL Hamra St. FROM EAST				AL Hamra St. FROM WEST				TOTALS				PEDESTRIANS						
	L	A	R	TOT	L	A	R	TOT	L	A	R	TOT	L	A	R	TOT	N-S	E-W	ALL	N	S	E	W	N-S	E-W	TOTAL	
MID- NITE																											
1 A.M. - 2 A.M.																											
2 A.M. - 3 A.M.																											
3 A.M. - 4 A.M.																											
4 A.M. - 5 A.M.																											
5 A.M. - 6 A.M.																											
6 A.M. - 7 A.M.	0	192	9	201	19	102	0	121	0	1	0	1	17	0	35	52	322	53	375								
7 A.M. - 8 A.M.	1	199	14	214	25	272	0	297	0	1	2	3	21	3	22	46	511	49	560								
8 A.M. - 9 A.M.	1	124	7	132	3	222	1	226	1	0	2	3	24	6	28	58	358	61	419								
9 A.M. - 10 A.M.	1	188	12	201	12	242	0	254	0	1	0	1	44	15	49	108	455	109	564								
10 A.M. - 11 A.M.	4	164	14	182	23	201	0	224	1	2	2	5	26	1	35	62	406	67	473								
11 A.M. - NOON	2	248	13	263	11	210	0	221	1	1	0	2	25	5	49	79	484	81	565								
NOON - 1 P.M.	4	274	9	287	20	222	3	245	2	2	0	4	19	7	44	70	532	74	606								
1 P.M. - 2 P.M.	7	298	20	325	10	220	3	233	5	4	8	17	5	8	26	39	558	56	614								
2 P.M. - 3 P.M.	5	207	12	224	24	250	9	283	0	3	3	6	15	1	33	49	507	55	562								
3 P.M. - 4 P.M.	6	258	18	282	31	278	3	312	0	1	2	3	14	11	38	63	594	66	660								
4 P.M. - 5 P.M.	3	215	12	230	30	363	5	398	3	2	2	7	19	7	45	71	628	78	706								
5 P.M. - 6 P.M.	1	247	23	271	27	318	3	348	2	3	2	7	23	8	21	52	619	59	678								
6 P.M. - 7 P.M.																											
7 P.M. - 8 P.M.																											
8 P.M. - 9 P.M.																											
9 P.M. - 10 P.M.																											
10 P.M. - 11 P.M.																											
11 P.M. - MID- NITE																											
TOTAL	35	2614	163	2812	235	2900	27	3162	15	21	23	59	252	72	425	749	5974	808	6782								
NO OF LANES	1				1				1				1				1				X						

Figure 4-8  
Example of a test for criterion 2, interruption of continuous traffic.

pretimed control or, if traffic-actuated, shall be coordinated with the system.

c. At school crossings between intersections, the signal shall be pedestrian-actuated. If within a progressive signal system, it shall be coordinated with that system. At such signalized locations, parking shall be prohibited for at least 30 m in advance of the crosswalk and 10 m beyond the crosswalk.

d. A school crossing signal shall not be installed within 150 m of another traffic control signal, and shall be located at least 30 m and preferably further from the nearest intersection.

#### **G. Criterion 5—Progressive Movement**

1. When the indications of a traffic control signal change from red to green, the vehicles proceeding ahead on the green signal form a group. These vehicles usually stay in the group for 500 m or more. The movement of traffic groups through a progressive signal system is more efficient than random movement of individual vehicles through the system.

Progressive signal systems control the speed of traffic. A vehicle which is driven at a high rate of speed between signals would arrive at the second signal before the green indication is shown. If traffic control signals are far apart, the vehicles within a group disperse and the signals do not regulate the speed of traffic. Thus, it may be desirable to install a traffic control signal at an intersection between signals which are quite far apart. This will help to preserve the efficient grouping of vehicles and regulate vehicle speed.

2. The Progressive Movement criterion may be applicable when all three conditions exist:

- a. The adjacent signals are more than 800 m apart.
- b. A traffic engineering study shows that the vehicles do not remain in groups.
- c. Vehicle speeds are considerably above a safe speed.

3. A traffic control signal shall normally not be installed if this criterion is satisfied when the resulting distance from that traffic signal to any adjacent signal would be less than 300 m.

#### **H. Criterion 6—Accident Experience**

1. A traffic control signal may reduce the number of certain types of accidents occurring at an intersection, although the signal will cause more delay to drivers. It may also cause an increase in other types of accidents. The Accident Experience criterion is satisfied

when all of the following conditions are met:

a. Other remedies such as improved signing, pavement markings and parking restrictions were tried but, no reduction in the number of accidents occurred.

b. Five or more accidents involving pedestrians, or right angle or left turn vehicle collisions, each of which caused personal injury or considerable property damage were reported to the police within a 12-month period.

c. The number of vehicles and pedestrians at the intersection is not less than 80 percent of the requirements in Criteria 1, 2, or 3.

d. The installation of a signal will not seriously disrupt the smooth flow of traffic in a progressive signal system.

2. Any traffic control signal installed solely on the Accident Experience criterion shall be traffic actuated. It may be semitrafic actuated when equipped with devices which provide proper coordination (if installed at an intersection within a coordinated system). It normally should be fully traffic actuated if installed at an isolated intersection.

3. Accident studies have shown the installation of a traffic control signal will significantly reduce the number of right angle collisions at an intersection. Right angle collisions are usually severe. A traffic control signal often will increase the number of rear-end collisions that are usually much less severe. Another type of accident which may be reduced by a traffic control signal is one involving pedestrians and vehicles.

4. When considering the removal of an existing traffic control signal, an analysis should be made of the accidents occurring at the intersection. The type and number of accidents that may occur if the signal were removed should be estimated. The vehicular and pedestrian volumes should also be considered. A thorough analysis of the existing and projected conditions at the intersection should indicate whether the signal should be removed or permitted to remain.

#### **I. Criterion 7—Combination of Criteria**

1. A traffic control signal may occasionally be justified when no single criterion is met. When at least 80 percent of the traffic volume required by paragraph No. 1 or 2 (as appropriate) of two or more of the first three Criteria (1, 2, and 3) are met, a traffic control signal may be justified.

2. Before a signal is installed under this criterion, there shall be adequate trial of other

remedies such as improved signing, pavement markings, and parking restrictions. A signal shall be installed only if other remedies do not correct the problems.

#### J. Criterion 8—Short Peak Period Traffic Volume Criterion

1. A traffic control signal may be indicated where, during only 1 or more hours of an average day, minor street traffic experiences unreasonable delay or hazard. There are two methods of determining when this criterion is met. One is by using the major street and minor street traffic volumes. The other is by measuring the delay to minor street traffic.

2. The volume criterion may be applied by plotting on Figure 4-9 or 4-10 (whichever is appropriate)

- the total traffic volume on the major street and
- the number of vehicles entering the intersection on the higher volume minor street approach. (Note: Figure 4-10 is to be used in communities with a population of less than 10,000, or the speed limit on the major street is 65 km/h or more.)

3. If the point plotted on the graph falls above the curve corresponding to the number of approach lanes, the criterion is met.

4. This criterion also applies when the conditions in a, b, and c are met:

a. During the peak traffic period traffic on a side street (controlled by a STOP sign) experiences a total delay per hour of

- four or more vehicle hours for a single-lane approach, or
- five or more vehicle hours for a two-lane approach.

b. The volume on the side street approach during the same hours is

- one hundred or more vehicles per hour for a single-lane approach, or
- one hundred and fifty vehicles per hour for a two-lane approach.

c. The total traffic entering the intersection on all approaches during the same hours is

- eight hundred or more vehicles per hour for intersections with four or more approaches, or
- six hundred and fifty vehicles per hour for intersections with three approaches.

#### K. Criterion 9—Estimate of Traffic on Street to be Constructed

1. This criterion may be used only to evaluate the need for a traffic signal at a newly constructed intersection, created or revised by a highway construction project, or at the driveway of a new commercial or residential development.

2. The anticipated traffic volume is estimated as of the date the intersection is opened to traffic, or

- within 2 years from the date of opening of a highway construction project or
- within 6 months from the date of the opening of a new commercial or residential development.

3. This criterion is met when the estimated average daily traffic volume on the major street and on the higher volume minor street or driveway approach to the intersection equals or exceeds the volumes of traffic shown in Table 4-4.

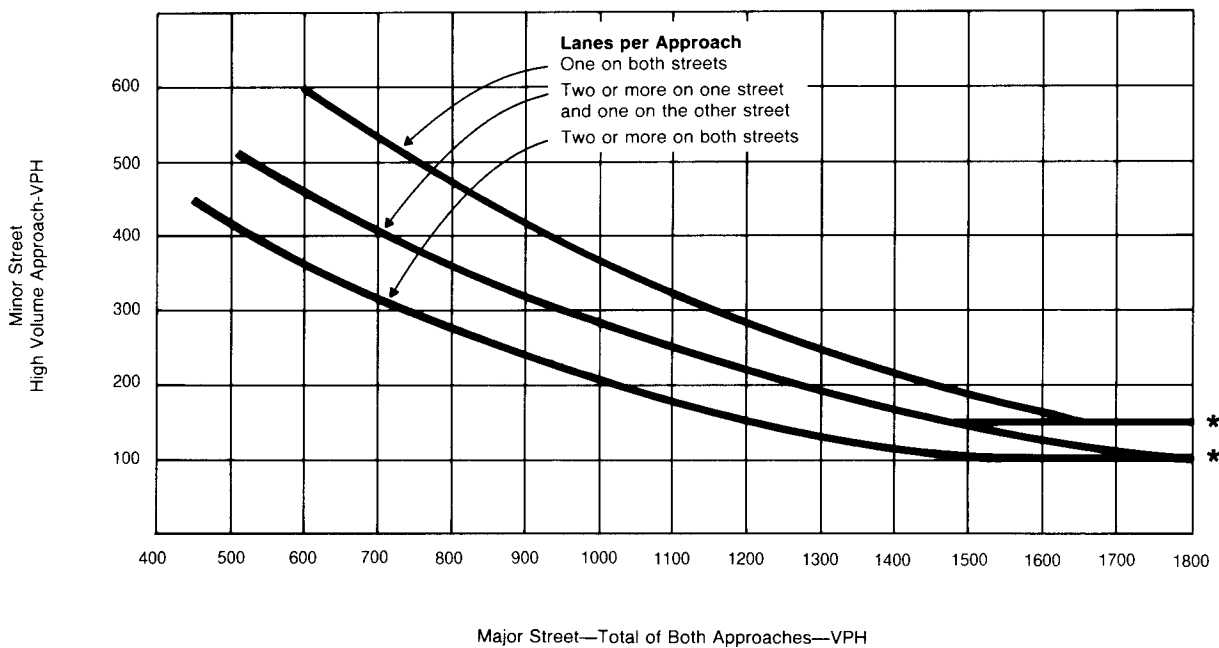
Table 4-4

#### Minimum Vehicular Volumes for Criterion 9

Number of Lanes for Moving Traffic on Each Approach		Average Daily Traffic	
Major Street	Minor Street	Major Street (both approaches)	Minor Street (one approach)
1	1	10,000	3,000
2 or more	1	12,000	3,000
2 or more	2 or more	12,000	4,000
1	2 or more	10,000	4,000
1	1	15,000	1,500
2 or more	1	18,000	1,500
2 or more	2 or more	18,000	2,000
1	2 or more	15,000	2,000

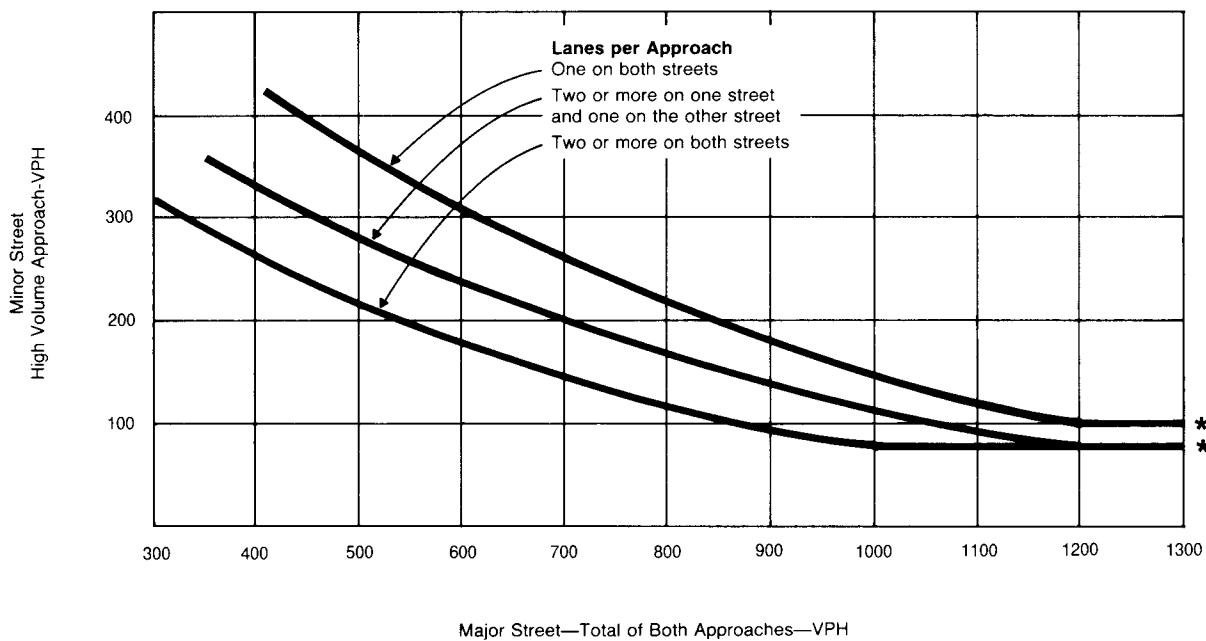
4. This criterion is also met if the traffic volumes are estimated to be 70 percent or more of those shown in the Table 4-4 when

- the speed of 15 percent of the traffic on the main street is 65 km/h or more, whether the intersection is in an urban area or a rural area or
- the intersection is in an area with frequent buildings (a built-up area) in a city or village having a population of less than 10,000, and it is not near a larger city or village.



**\*Note:**  
150 VPH applies as the lower threshold volume for a minor street approach with two or more lanes and 100 VPH applies as the lower threshold volume for a minor street approach with one lane.

**Figure 4-9**  
**Peak hour volume criteria.**



**\*Note:**  
100 VPH applies as the lower threshold volume for a minor street approach with two or more lanes and 75 VPH applies as the lower threshold volume for a minor street approach with one lane.

**Figure 4-10**  
**Peak hour volume criteria (less than 10,000 population or above 65 km/h).**

#### **L. Selection of Pretimed or Traffic-Actuated Control**

1. Pretimed traffic control signals are generally the most appropriate type for the following conditions:

- a. A repeated, predictable traffic volume pattern.
- b. An intersection in the built-up area of a city or village.

2. Unless an intersection is or will be in a coordinated signal system, traffic-actuated signals may be used in place of pretimed signals. Traffic-actuated signals are also appropriate for the following conditions:

- a. When the volume of traffic is low, changes frequently through the day, or is greater first on one approach and then on others.
- b. When the side street vehicles are numerous only during a few peak hours per day, and those are the only hours when considerable delay is experienced on the side street.
- c. When only the pedestrian or accident criterion is used.

d. When the signal will not be installed at an intersection.

e. When the signal will be at an isolated location, that is 2 km from the nearest signalized intersection.

#### **M. Pedestrian Actuation of Traffic Control Signals**

1. Pedestrian detectors (usually pushbutton switches at the ends of crosswalks) shall be installed with a traffic-actuated traffic control signal when pedestrians would have to wait an unreasonable length of time for a vehicle actuation to give them an opportunity to cross.

2. Pedestrian detectors shall be installed with a traffic-actuated traffic control signal if pedestrians would not have sufficient time to cross the intersection during a green signal indication for vehicles.

#### **N. Signal Criteria Analysis Form**

1. Figures 4-11 and 4-12 show convenient forms used to summarize the data, which determine if one or more of the traffic signal criteria are met.



# Traffic Signal Criteria Analysis Form

CITY Dammam RTE. \_\_\_\_\_ CALC HE DATE 17 Shaban 1398  
CHK EW DATE 19 Shaban 1398

Major St: Ammam Blvd. Critical Approach Speed > 65 km/h mph Lanes 1  
Minor St: Mansour St. Critical Approach Speed < 65 km/h mph Lanes 1

70% VOL. 100% VOL.  
Critical speed of major street traffic ► 65 km/h ..... ☒ YES ☐ NO  
In built up area of isolated community of ◀ 10,000 pop. .... ☒ YES ☐ NO  
Applicable Minimum Volume Requirements: ☒ 70% ☐ 100%

## CRITERION 1—Minimum Vehicular Volume

MINIMUM REQUIREMENTS (80% Shown in Brackets)					100% SATISFIED								Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>		
					80% SATISFIED								Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>		
100%		70%			100%		70%									
APPROACH LANES	1			2 or more		1600	1700	1500	1300	1200	700	1400	1100	Hour		
Both Apprchs. Major Street	500 (400)	350 (280)		600 (480)	420 (336)	628	619	594	558	532	511	507	484			
Highest Apprch. Minor Street*	150 (120)	105 (84)		200 (160)	140 (112)	71	52	63	39	70	46	49	79			

\*NOTE Heavier of left turn movement from Major Street included when LT-phasing is proposed ☐

## CRITERION 2—Interruption of Continuous Traffic

MINIMUM REQUIREMENTS (80% Shown in Brackets)					100% SATISFIED								Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	
					80% SATISFIED								Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
100%		70%		100%		70%									
APPROACH LANES	1		2 or more		1600	1700	1500	1200	700	1400	1100	900	Hour		
Both Apprchs. Major Street	750 (600)	525 (420)	900 (720)	630 (504)	628	619	594	532	511	507	484	455			
Highest Apprch. Minor Street*	75 (60)	53 (42)	100 (80)	70 (56)	71	52	63	70	46	49	79	108			

\*NOTE Heavier of left turn movement from Major Street included when LT-phasing is proposed ☐

## CRITERION 3—Minimum Pedestrian Volume

MINIMUM REQUIREMENTS (80% Shown in Brackets)				100% SATISFIED								Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Median		100%	70%									Hour	
Both Approchs. Major Street	No Median	600 (480)	420 (336)										
Volume	Raised 4' Median	1000 (800)	700 (560)										
Ped's On Highest Volume X-Walk Xing Major Street		150 (120)	105 (84)										

IF MIDBLOCK SIGNAL PROPOSED ☐

MIN. REQUIREMENT	DISTANCE TO NEAREST ESTABLISHED CRWLK.	FULFILLED
150 Feet	N/E _____ ft S/W _____ ft	Yes <input type="checkbox"/> No <input type="checkbox"/>

## CRITERION 4—School Crossings

Not Applicable  
See School Crossings Warrant Sheet



Figure 4-11  
Completed traffic signal criteria analysis form (page 1).



## Traffic Signal Criteria Analysis Form

### CRITERION 5—Progressive Movement

Satisfied Yes ☐ No ☒

MINIMUM REQUIREMENTS	DISTANCE TO NEAREST SIGNAL	FULFILLED	
► 305	N <u>610</u> S <u>∞</u> E <u>∞</u> W <u>185</u>	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
ON ISOLATED ONE WAY ST OR ST WITH ONE-WAY TRAFFIC SIGNIFICANCE, ADJACENT SIGNALS ARE SO FAR APART THAT NECESSARY PLATOONING & SPEED CONTROL WOULD BE LOST			
ON TWO-WAY ST WHERE ADJACENT SIGNALS DO NOT PROVIDE NECESSARY PLATOONING & SPEED CONTROL, PROPOSED SIGNALS COULD CONSTITUTE A PROGRESSIVE SIGNAL SYSTEM		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

### CRITERION 6—Accident Experience

Satisfied Yes ☐ No ☒

REQUIREMENT	CRITERION	✓	FULFILLED	
ONE CRITERION	CRITERION 1—MINIMUM VEHICULAR VOLUME			
SATISFIED	OR			
80%	CRITERION 2—INTERRUPTION OF CONTINUOUS TRAFFIC	✓	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
	OR			
	CRITERION 3—MINIMUM PEDESTRIAN VOLUME			
SIGNAL WILL NOT SERIOUSLY DISRUPT PROGRESSIVE TRAFFIC FLOW			Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
ADEQUATE TRIAL OF LESS RESTRICTIVE REMEDIES HAS FAILED TO REDUCE ACC. FREQ.			Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
ACC. WITHIN A 12 MON. PERIOD SUSCEPTIBLE OF CORR. & INVOLVING INJURY OR MAJOR DAMAGE				
MINIMUM REQUIREMENT	NUMBER OF ACCIDENTS			
5 or more*	<u>3</u>		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

\*NOTE: Left turn accidents can be included when LT-phasing is proposed

### CRITERION 7—Systems Criterion

Satisfied Yes ☐ No ☒

MINIMUM VOLUME REQUIREMENT	ENTERING VOLUMES ALL APPROACHES	✓	FULFILLED	
800 VEH/HR	DURING TYPICAL WEEKDAY PEAK HOUR			
	_____ VEH/HR			
	DURING EACH OF ANY 5 HRS OF A ALKAMEES AND/OR ALJUMGAH			
	_____ VEH/HR		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
CHARACTERISTICS OF MAJOR ROUTES				
PART OF HWY SYSTEM SERVING AS PRINCIPAL NETWORK FOR THROUGH TFC		✓		
CONNECTS AREAS OF PRINCIPAL TRAFFIC GENERATION		✓		
RURAL OR SUBURBAN HWY OUTSIDE OF ENTERING OR TRAVERSING A CITY		✓		
HAS SURFACE STREET FWY OR EXPWAY RAMP TERMINALS		✓		
APPEARS AS MAJOR ROUTE ON AN OFFICIAL PLAN		✓		
ANY MAJOR ROUTE CHARACTERISTICS MET. BOTH STS.			Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

### CRITERION 8—Combination of Criterion

(Used if no one criterion satisfied 100%)

Satisfied Yes ☐ No ☒

REQUIREMENT	CRITERION	✓	FULFILLED	
TWO CRITERION	1. MINIMUM VEHICULAR VOLUME			
SATISFIED	2. INTERRUPTION OF CONTINUOUS TRAFFIC	✓		
80%	3. MINIMUM PEDESTRIAN VOLUME		Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>

The satisfaction of a criterion is not necessarily justification for signals delay, congestion, confusion or other evidence of the need for right of way assignment must be shown

CONCLUSIONS Traffic Signal Criterion: ☒ No ☐ Yes, Criterion Nos. \_\_\_\_\_

REMARKS: \_\_\_\_\_

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Figure 4-12  
Completed traffic signal criteria analysis form (page 2).

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## **4.03 Traffic Control Signal Indications**

### **A. Meaning of Vehicular Traffic Control Signal Indications**

1. Green traffic signal indications shall have the following meanings:

a. Traffic, except pedestrians, facing a **GREEN DISK** indication may proceed straight through an intersection or turn right or left. However, signs, pavement markings, or roadway design may prohibit or prevent one or more of those movements. Drivers shall yield the right-of-way to vehicles and pedestrians already lawfully within the intersection or adjacent crosswalk.

b. Traffic, except pedestrians, facing a **GREEN ARROW** indication, shown alone or in combination with another indication, may cautiously enter the intersection only to make the movement specified by the arrow or by the other indication. Drivers shall yield the right-of-way to vehicles and pedestrians already lawfully within the intersection or adjacent crosswalk.

c. Pedestrians facing a **GREEN DISK** indication may proceed across the roadway within the crosswalk, unless prohibited from doing so by a pedestrian signal.

2. Yellow traffic signal indications shall have the following meanings:

a. Traffic, except pedestrians, facing a steady **YELLOW DISK** or **YELLOW ARROW** indication is warned that the movement which had been allowed by the corresponding green indication is being terminated.

b. A steady **YELLOW DISK** or **YELLOW ARROW** indication tells pedestrians that there is no longer sufficient time to cross the roadway before a red indication is shown.

c. A flashing **YELLOW DISK** indication is a warning to drivers to proceed through an intersection or past the flashing traffic signal with caution. This indication may also be used to call the attention of drivers and pedestrians to Warning or Regulatory signs except for the **STOP**, **Give Way** and **No Entry** signs.

3. Red traffic signal indications shall have the following meanings:

a. Traffic, except pedestrians, facing a steady **RED DISK** or **RED ARROW** indication shall stop at the marked stop line before entering the intersection. Traffic

shall remain standing until an indication to proceed is shown, except as otherwise provided for. If a marked stop line does not exist, the stop shall be made before entering the crosswalk. If a marked crosswalk does not exist, the stop shall be made before entering the intersection.

b. Pedestrians facing a steady **RED DISK** indication alone shall not enter the roadway unless permitted to do so by a pedestrian indication.

c. Drivers of vehicles approaching a flashing **RED DISK** indication shall stop at the marked stop line. The right to proceed shall be governed by rules applicable after making a stop at a **STOP** sign. If a marked stop line does not exist, the stop shall be made before entering the crosswalk. If a marked crosswalk does not exist, the stop shall be made before entering the intersection.

### **B. Use of Traffic Control Signal Indications**

#### **1. Nonflashing Indications**

a. A **RED DISK** indication is used as follows:

(1) It shall be shown when it is intended to prohibit traffic, except pedestrians directed by a pedestrian signal, from entering an intersection or other controlled area. A pedestrian crossing between intersections is an example of such a controlled area.

(2) It shall not be shown with a right or left **GREEN ARROW** indication, which is the only other illuminated indication in that face (except as provided in Section 4.03 B 4a). It shall not be shown with the right or left **YELLOW ARROW** change indication, which follows a **GREEN ARROW** indication shown alone.

(3) It shall be shown with a right or left **GREEN ARROW** indication when traffic is allowed to turn but is not allowed to proceed straight ahead. It shall also be displayed with the **YELLOW ARROW** indication, which follows the **GREEN ARROW** indication in this case.

b. A **YELLOW DISK** indication is used as follows:

(1) It shall be shown when it is necessary to inform approaching traffic the right-of-way is about to change, except when a **YELLOW ARROW** indication

is required (Section 4.03 B4a).

(2) It shall be used rather than the **YELLOW ARROW** indication following a **GREEN ARROW** indication shown alone, when the indications are visible only to traffic which these signals control.

c. A **GREEN DISK** indication is used as follows:

(1) It shall be shown only when traffic facing the signal is permitted to proceed in any direction which is lawful and practicable. However, this restriction may be modified by signs prohibiting specific movements, usually at stated times.

(2) It shall not be shown at the same time to two traffic movements whose paths would cross or otherwise conflict.

## 2. Arrow Indications

a. **YELLOW ARROW** and **GREEN ARROW** indications shall normally be used in the following locations:

(1) At an intersection with a one-way street.

(2) Where some movements are prohibited or are physically impossible.

(3) Where there is a separate, sheltered lane intended only for a specific traffic movement.

(4) Where some of the vehicular movements on an approach do not begin or end at the same time as other vehicular movements. This rule applies only when signal indications for turning vehicles are visible to other traffic on that approach. A **RED ARROW** indication may also be used.

(5) A **YELLOW ARROW** indication shall be used only to show a change in the right-of-way granted by a **GREEN ARROW** indication. This is required when the indications are visible to all traffic on the approach. When **GREEN ARROW** and **GREEN DISK** indications terminate at the same time, only a **YELLOW DISK** indication shall be shown.

(6) A **YELLOW ARROW** indication shall not be displayed when any conflicting movement has a green or yellow indication.

(7) A **GREEN ARROW** indication shall be displayed only when the path of the vehicles proceeding in the direction of the arrow:

(a) Does not conflict with the path of

other vehicles moving lawfully in response to other green or yellow signal indications; and

(b) Does not cross a crosswalk to which pedestrian Walk indications are being shown at the same time.

b. Typical Arrow Indication format is shown on page 4-23.

## 3. Prohibited Combinations of Traffic Control Signal Indications

a. The following combinations of traffic signal indications shall not be shown simultaneously on any **one** signal face:

(1) **GREEN DISK** with **YELLOW DISK**.

(2) Straight-through **GREEN ARROW** with **RED DISK**.

(3) **RED DISK** with **YELLOW DISK**.

(4) **GREEN DISK** with **RED DISK**.

b. The above combinations shall not be simultaneously displayed on different signal faces on any one approach, unless the following are true:

(1) One of the signal faces controls only traffic in a lane intended only for turning vehicles and is identified as a left or right turn signal, or

(2) One of the signal faces controls only the traffic in a lane intended only for turning vehicles, and

(a) the indications on that signal face are only a **RED DISK** (or a **RED ARROW**), **YELLOW ARROW** and **GREEN ARROW**, and

(b) at least the **RED DISK** indication is visible only to traffic it controls.

(3) Or, as an alternative to (1) and (2), the signal indications are screened, covered, louvered, positioned, or designed so the combination of indications is not confusing to approaching drivers.

c. None of these traffic signal indications shall be used:

(1) A straight-through **YELLOW ARROW**.

(2) More than two arrow indications illuminated at the same time.

(3) The combination of a **YELLOW DISK** indication and a **YELLOW ARROW** indication normally shall not be shown. Where possible, only the **YELLOW DISK** shall be shown except in those unusual situations where elimina-

tion of the **YELLOW ARROW** causes traffic signal controller design and operating problems.

(4) A 200 mm **RED DISK** indication in the same signal face with 300 mm **YELLOW DISK** or **GREEN DISK** indications.

#### 4. Indications That May Follow Other Indications:

a. Each color, type, and combination of steady (nonflashing) traffic control signal indication in any one signal face may only be followed by the showing of an approved steady "following" display. The approved "following" displays are listed in Table 4-5 for normal operation. Additional "following" displays allowed when the signal is preempted by an emergency vehicle or a train, are shown in Table 4-6. No other "following" displays may be used.

b. Traffic control signals at intersections near railroad crossings are normally connected electrically to the warning signals for the crossing (Section 7.03 H). The approach of a train preempts the traffic control signal from its normal operation. Equipment is also available to permit emergency vehicles (fire, police, ambulance) to preempt the operation of traffic control signals.

Any change in the operation of the traffic control signal to clear the tracks or the intersection must take place promptly. To accomplish this, signal indications may be followed by indications which would not normally succeed them. However, these succeeding indications shall not result in conflict between vehicles moving legally in accordance with any green or yellow indication.

#### 5. When Traffic Control Signal Indications Are Flashed

a. The following requirements apply when a traffic control signal is put on flashing operation by a time clock or other automatic mechanism:

(1) The signal indications shall be either flashing **RED DISKS** on all approaches, or flashing **YELLOW DISKS**

on the major street approaches and flashing **RED DISKS** on the minor street approaches.

(2) Flashing yellow indications shall never be shown to all approaches.

(3) **YELLOW ARROW** indications shall never be flashed. If a traffic control signal with a signal face having a **YELLOW ARROW** indication must be flashed, the face shall also have a **YELLOW DISK** indication. Only the **YELLOW DISK** indication shall be flashed in that signal face when the traffic control signal is put on flashing operation.

(4) A **GREEN DISK**, **GREEN ARROW**, or flashing **YELLOW DISK** indication shall normally be followed by a steady **YELLOW DISK** indication. That indication shall then be followed by a steady or flashing **RED DISK** indication.

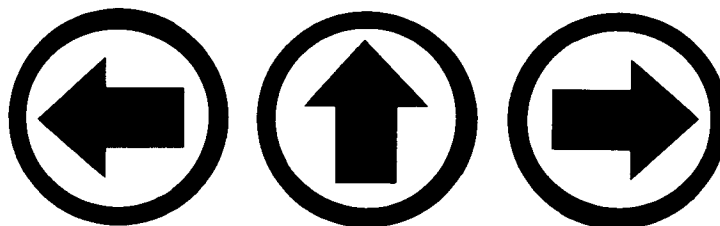
(5) However, when a traffic control signal is being changed to flashing operation, a **GREEN DISK** or **GREEN ARROW** indication may be followed by a flashing **YELLOW DISK** indication.

(6) All signal faces on an approach shall flash the same color of circular indication. However, the **RED DISK** or **RED ARROW** indication in a left turn signal face may be flashed rather than the **YELLOW DISK**. This is allowed when the red indication is screened, louvered, positioned or designed so through traffic will not be confused by the flashing indication from the left turn signal face. The flashing yellow signal indications for through traffic may be visible to drivers in the left turn lane.

b. When flashing operation is commenced by the "emergency flash" manual switch in the traffic signal controller cabinet, the indications shall immediately change to one of the following preselected flashing conditions:

(1) Red on all signal faces.

(2) Red on the minor street and yellow on the major street. (The left turn indication may be flashed as described in Sections 4.03 B5a (3) and (6) ).



Typical Arrow Indications

**Table 4-5**  
**Permissible Sequential Traffic Control Signal Indications**

Existing Indication or Indications	Permissible Following Indications In the Same Signal Face															
								Use only at "T" Intersections								

**Table 4-5 (cont.)**  
**Permissible Sequential Traffic Control Signal Indications**

Existing Indication or Indications	Permissible Following Indications In the Same Signal Face															
	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔
➔	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔
➔ ●	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔
➔ ●	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔
● ➔	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔
➔ ➔	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔
➔	●	●	➔	●	●	➔	●	➔	●	➔	●	➔	●	➔	●	➔

Note: The practicality of some sequences depends on holding opposing traffic movements by appropriate signal indications.  
 Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Table 4-6**  
**Additional Permissible Sequential Traffic Control Signal Indication**  
**During Signal Preemption Phase**

Existing Indication or Indications				Permissible Following Indications In the Same Signal Face															
●	●	●	●	None															
		⬆	⬆	●	●	●	⬆	⬆	⬆	●	●	⬆	⬆	⬆	⬆	●	⬆	●	⬆
⬆	⬆	●		None															
●	⬆	⬆		None															
	●			●	⬆														
	⬆			●	⬆	●	⬆	⬆											
	●			●	⬆	●	⬆	⬆											
	⬆			⬆	⬆	⬆													
				●	⬆	⬆													
	●			●	⬆	⬆	⬆												
	⬆			●	⬆	●	⬆	⬆											
	●			⬆	⬆	⬆													
	⬆			⬆	⬆	⬆													
				●	●	⬆	⬆	⬆											
	⬆			●	⬆	⬆	⬆	⬆											
	⬆			●	⬆	●	⬆	⬆	⬆										

Note: The practicality of some sequences depends on holding opposing traffic movements by appropriate signal indications.  
 Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

## 4.04 Design and Location of Vehicular Traffic Control Signal Indications

### A. Size and Design of Traffic Signal Lenses

1. All traffic control signal lenses, except pedestrian signals, shall be circular. The circular lenses shall have a visible diameter closely approaching either 200 mm or 300 mm. The lenses shall be red, yellow, or green in color.

2. The following traffic control signal equipment shall meet or exceed the General Specifications and Standard Drawings of the Ministry of Communications:

- a. Lenses, with respect to color, light transmittance, and arrow design.
- b. Reflectors, with respect to reflectivity.
- c. Complete optical units, with respect to horizontal and vertical light distribution.
- d. Wiring, housing, visors, and hardware, with respect to the pertinent electrical and mechanical characteristics.

3. The 300 mm lenses shall be used:

- a. On intersection approaches where more than 15 percent of the traffic is approaching at speeds in excess of 65 km/h.
- b. For all arrow indications.
- c. For special problem locations, such as those where background lighting or advertising signs conflict or compete with the traffic control signal indications.
- d. On any approach where the minimum visibility distance and location requirements of Section 4.04 E cannot be met.
- e. For locations where traffic control signals might be unexpected, including for example:

- (1) A signal which is a short distance beyond a hillcrest.
- (2) The first signal on an approach to a city or village.
- (3) A signal in a rural area.

4. Arrow indications shall be pointed vertically upward to show a straight through movement. Arrow indications shall be pointed horizontally to indicate a turn at approximately right angles. When the angle of the turn is substantially different from a right angle, the arrow shall be pointed at an angle which will approximately equal that of the turn.

5. Each arrow lens shall show only one arrow direction. The arrow indication shall be the only illuminated part of the lens which is visible.

6. In no case shall letters, numbers, or symbols be displayed as part of a vehicular traffic control signal indication.

### B. Number and Arrangement of Indications in a Traffic Control Signal Face

1. The indications in each traffic control signal face shall be arranged in either a vertical or a horizontal straight line. The only permissible exception is that in a vertical arrangement, indications of the same color may occasionally be located horizontally adjacent to each other. This is only permissible where space is not available for a normal vertical arrangement. Not more than two identical indications or three different indications of the same color may be grouped together in this manner.

2. The relative positions of indications within a signal face shall be as follows:

- a. In a vertical signal face from top to bottom:

RED DISK.

Left turn RED ARROW.

Right turn RED ARROW.

YELLOW DISK.

GREEN DISK.

Straight through GREEN ARROW.

Left turn YELLOW ARROW.

Left turn GREEN ARROW.

Right turn YELLOW ARROW.

Right turn GREEN ARROW.

- b. In a horizontal signal face from left to right:

RED DISK.

Left turn RED ARROW.

Right turn RED ARROW.

YELLOW DISK.

Left turn YELLOW ARROW.

Left turn GREEN ARROW.

GREEN DISK.

Straight through GREEN ARROW.

Right turn YELLOW ARROW.

Right turn GREEN ARROW.

3. The RED DISK indication shall always be at the top of a vertical signal arrangement and at the left side of a horizontal arrangement. When used, a YELLOW DISK indication shall always be located between the red indications and all other indications.

4. Each signal face shall have at least three indications but not more than five, with the following exceptions:

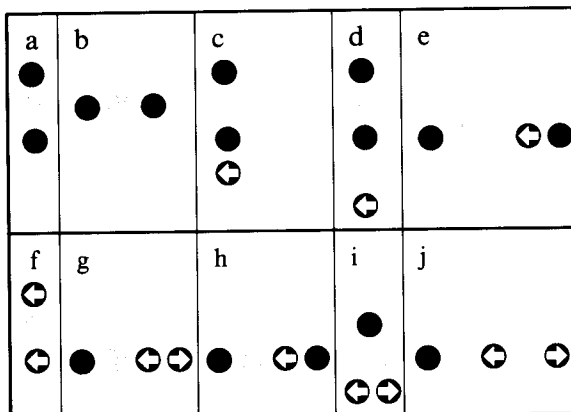
- a. A single GREEN ARROW indication

shall be used alone to permit a continuous movement.

b. Pedestrian signal faces, which have two indications.

5. One or more indications in a signal face may be repeated for safety or increased effectiveness. For instance, two red indications may be placed in adjacent vertical or horizontal locations in a signal face with three other indications. However, this shall be done only when other improvements, such as increasing the size of the lenses, has not produced satisfactory results. Either horizontally or vertically arranged signal faces, or both arrangements, may be used on the same intersection approach.

6. Some of the most commonly used permissible arrangements of indications in traffic signal faces are shown in Figure 4-13.



Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-13**

**Typical arrangements of indications in signal faces.**

### C. Illumination of Traffic Control Signal Lenses

1. Each traffic signal lens shall be illuminated separately.

2. An unobstructed, illuminated vehicular traffic control signal indication shall be sufficiently bright to be clearly visible for a distance of at least 400 m under normal atmospheric conditions. See Section 4.06 for visibility of pedestrian signal indications.

3. Traffic control signal lenses with a diameter of 300 mm which have 1,750 lumen lamps may have to be flashed at night. If so, a dimming device shall be used to proportionally reduce the light output of the indication. The output shall decrease in proportion to the decrease in ambient light to a minimum of not less than 30 percent nor more than 50 percent of the light output at full rated voltage when the ambient light has

decreased to its lowest level. Except in urban areas with bright surroundings and on high speed rural roads, all indications of a traffic control signal may be dimmed at night to the maximum amount indicated above, after an engineering study.

### D. Visibility and Shielding of Signal Faces

1. Every signal head and its supports shall be designed so each signal face may be aimed independently of any other signal face.

2. Every signal face shall be aimed so its indications will have maximum visibility to the traffic it is intended to control. Each signal face should normally be aimed at a point approximately 1 m above the approach roadway, substantially in advance of the stop line. The distance from the stop line to this point should be approximately the distance traveled by a vehicle while the driver reacts to the signal indication and stops. This distance is shown in Table 4-7. An upgrade on the approach to a signal will reduce the required vehicle stopping distance, while a downgrade will increase that distance. When the approach grade is about 5 percent or more, it would be desirable to adjust the minimum visibility distances shown in Table 4-7 to compensate for the required decrease or increase in stopping distance.

**Table 4-7**

**Required Advance Visibility of Traffic Control Signal Indications**

85 Percentile Speed km/h	Minimum Visibility Distance (Meters)
30	50
40	65
50	85
60	110
70	135
80	165
90	195
100	230
110	265
120	295

3. It is important that signal indications not be visible to drivers who are not controlled by those indications. For this reason, visors shall be used around all signal lenses. Visors also reduce "sun phantom" which gives an unlighted lens the false appearance of being lighted when it is facing a low sun.

4. The control of the visibility and effectiveness of signal indications can be improved by shielding, long visors, and louvers, and by special optical design. Where streets inter-

sect at a small angle, these devices shall be used to limit the visibility of the signal indications as much as practicable to the drivers the signals control. However, visors exceeding 300 mm in length shall only be used on signal heads which are rigidly supported so that they do not swing.

5. Street, commercial, and advertising lighting behind and in line with traffic signal indications may seriously interfere with signal visibility and effectiveness. Backplates (a strip of thin material extending outward approximately 125 mm parallel to the signal face on all sides of the signal housing) are available. Backplates shall be used on all signal heads placed over the roadway. Backplates shall also be used on all other signal heads located where background colors and lights would interfere substantially with the effectiveness of the traffic signal indications. The front surface of backplates, the inside surfaces of visors, and the entire surface of louvers and fins shall have a flat black finish. A backplate may have a white or silver border.

#### **E. Number and Location of Signal Faces**

1. The primary consideration in the placement of signal faces is the visibility and effectiveness of the indications. Drivers approaching a signalized intersection or other area, shall be given a clear and unmistakable indication of whether they shall stop, proceed, turn right or turn left. The most important physical conditions affecting visibility of the signal indications are the lateral and vertical angles of a driver's view toward a signal face. These angles are determined primarily by the height, distance beyond the intersection, and lateral placement of the signal face. Other considerations include the design of the vehicle, the curvature and gradient of the approach roadway, and the height of the driver's eyes above the roadway.

2. The visibility, location, and number of signal faces for each approach to an intersection or other signalized area shall be as follows:

a. A minimum of two signal faces shall be provided for through traffic. These faces shall normally be continuously visible from a point at least the distances shown in Table 4-7 in advance of and to the stop line. However, it is usually not desirable to allow motorists to see the indications of another traffic control signal which must be located less than the distances shown in Table 4-7 beyond a signal. On an approach that does not continue beyond the

intersection, at least one (and preferably both) of the turning movements from that approach shall have signal indications placed in accordance with this paragraph.

b. The optical axis of signal indications should be aimed directly at the point on the approach which is at the distance shown in Table 4-7 from the stop line. If sight distance along an approach is less than given in Table 4-7, the indication should be aimed at the point on the approach where the indication will first become visible.

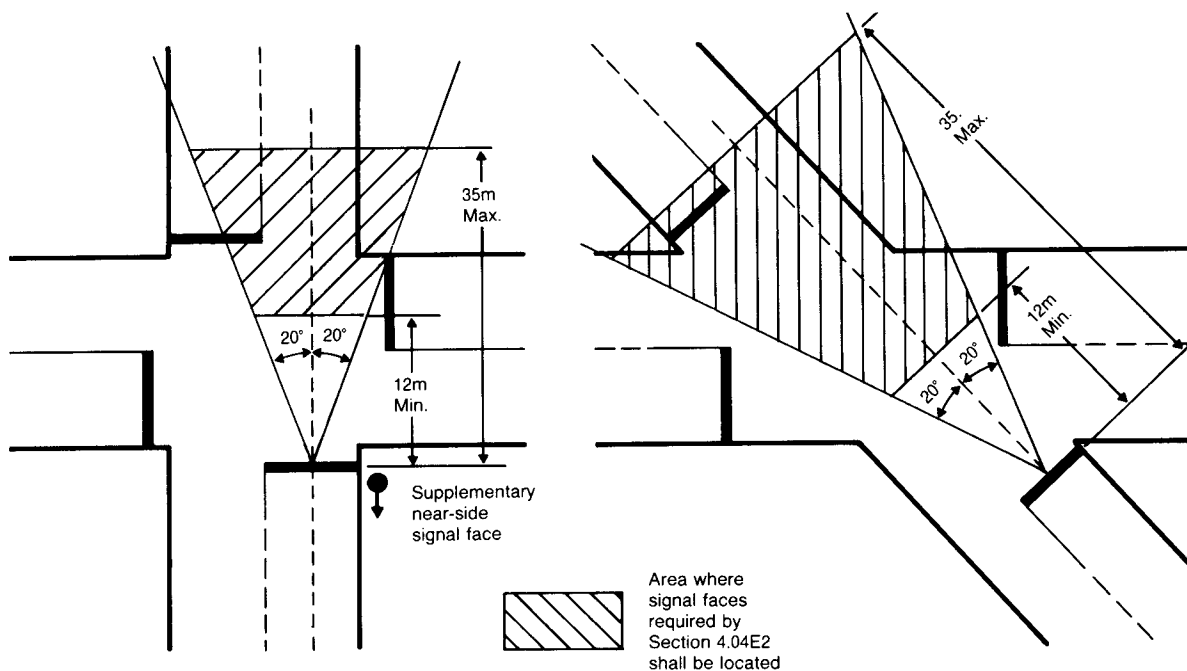
c. Physical obstructions to signal visibility, such as tree limbs, parked vehicles, horizontal or vertical roadway curvature, buildings, etc., shall be removed when practicable.

d. Physical conditions may prevent drivers from having a continuous view of at least two signal indications for the distance stated in Table 4-7. In such cases, a Signal Ahead sign (W 15) shall be erected to warn approaching traffic. The sign should also be erected in advance of signals in rural areas, the first signal encountered when entering a municipality, or wherever signals may be unexpected. This sign may be supplemented by a Hazard Identification Beacon.

e. Separate signal faces shall be used when turning movements protected from conflicting movements are allowed by GREEN ARROWS.

f. A single face is permissible for the control of traffic in a lane intended only for turning traffic. Two signal faces shall be provided where more than one lane turns, or where the turning traffic is the major movement from the approach. An additional face shall also be used when the required indication cannot be placed in an effective location. This signal face or faces shall be in addition to the two signal faces required for through traffic. Signal indications for turning traffic shall be adjusted to have as little visibility as practicable from the through traffic lanes. Where the signal indications will be visible to through traffic, identification as a left (or right) turn signal shall be placed near each such signal face.

g. Except where physically impractical, at least one and preferably both of the signal faces required by paragraph E2a, of this section, shall be located within the approved area shown in Figure 4-14. In only rare exceptions will the width of the intersecting streets or other conditions make it physically impracticable for the faces to



**Figure 4-14**  
**Required location of signal faces.**

be in that area. Boundaries of the approved area are defined by the following limits:

- (1) Two lines parallel to the center line of the intersected street, one 12 m and the other 35 m beyond the stop line.
  - (2) Two lines intersecting at the center of the full width of the approach lanes at the stop line. Each line makes an angle of approximately 20° with the center of the approach extended, one to the right and the other to the left.
- h. Where conditions require the nearest signal face to be more than 35 m but less than 45 m beyond the stop line, either
- (1) three hundred mm lenses shall be used in those signal faces or
  - (2) a supplementary post-mounted "near-side" signal face shall be placed on the right-hand side of the approach roadway as near as practicable to the stop line.
- i. Where the nearest signal face must be 45 m or more beyond the stop line, both the 300 mm lenses and the near-side supplementary signal face shall be installed.
- j. Signal faces beyond the far-side curb of the intersected street shall be as nearly straight ahead of the approaching driver as practicable, considering physical conditions and the means chosen for supporting the signal heads.

k. A signal face may be located on the near side, immediately in advance of an intersection at the right side, on a median island, or at both locations. Such signals shall be mounted on the top of the supporting post or by a short bracket attached to it. The signal face shall be as near as practicable to the stop line.

l. The lateral separation of the two signal faces required by paragraph E2a of this section shall be not less than 2.5 m measured horizontally between the centers of the faces.

m. Signal faces for an approach shall control traffic on all lanes of that approach, except lanes intended only for "protected" turning or other special traffic movements. "Protected" movements are those which do not conflict with other movements occurring at the same time. Signal faces are not required for each lane of an approach to a signalized area.

n. A signal face controlling a turning or special traffic movement shall be located as near as practicable in line with the path of that movement. Such a signal face should be in a position where it will be readily visible to drivers it controls.

o. Signal faces, in addition to those required by paragraphs E2a, E2e, and E2f of this section, may be used. However, these signal faces should be used only when a study has shown the signals are needed to

improve signal visibility in advance of or at the intersection.

p. Left turn arrows shall not be used in signal faces located on the near right-hand side of an approach.

q. Right turn arrows shall not be used in signal faces in the following locations:

(1) On the far left-hand side of an intersection.

(2) On a signal mounted on a median island on the far side of an intersection.

r. At signalized locations between intersections, at least one signal face shall be over and in line with the roadway of each approach. The other signal face required by paragraph E2a of this section, shall be mounted at the right-hand side of the roadway at a height of between 2.5 and 3 m. On streets and highways having multi-lane approaches, an additional signal face should be installed at the left-hand side of the approach or on a median island of adequate width. In all other respects, the requirements for a signal between intersections shall be the same as for a signal at an intersection.

s. Pedestrian signal indications shall be used where warranted as stated in Section 4.06.

t. Standard approved signal head locations and indications for common and typical situations are shown in Figures 4-15 to 4-18. Other arrangements are possible within the general rules given herein. The meanings of the terms "permissive," "protected," and "protected/permissive" will be found in the Glossary. A protected period is "leading" when it precedes the GREEN DISK indication on the same street. It is said to be "lagging" if it follows that GREEN DISK indication.

#### **F. Height of Signal Faces**

1. A signal face is most visible when directly in the driver's line of sight. Intersection approach grades, lateral offset of the signal, vehicle design and driver position affect signal visibility. A signal should be as low as possible and yet give adequate vertical clearance over the roadway. All of the indications in a horizontal signal face will have the same minimum roadway clearance. Unless there are vertical clearance problems, all signal arrays should be vertical. The vertical array shall be used for signals not over the roadway.

2. Except as otherwise provided herein, the bottom of the housing of a signal face not mounted over a roadway shall be not less

than 2.5 m nor more than 4.5 m above the sidewalk. A height of 2.5 to 3 m is generally best. If no sidewalk exists, the measurement shall be above the grade of the pavement at the center of the highway.

3. The bottom of the housing of a signal face placed on a median island on the near side of an intersection approach shall not be less than 1.25 m and not more than 2.5 m above the top of the median island.

4. The bottom of the housing of a signal face supported over a roadway shall not be less than 5.5 m nor more than 6.5 m above the pavement below the signal.

5. Typical mast arm and bracket mountings of signals are shown in Figures 4-19 and 4-20.

#### **G. Design and Location of Traffic Control Signal Supports and Controller Cabinets for Safety**

1. Proper visibility of traffic signal faces is the primary consideration in the location of traffic signal supports. In the interest of safety, signal support shall be placed as far as practicable from the edge of the traveled way without adversely affecting the visibility of the signal.

2. Supports for post-mounted signal heads and also signal heads at the side of a street shall be placed not less than  $\frac{1}{2}$  m back from the face of a curb. If there is no curb the supports and signal heads shall be placed not less than  $\frac{1}{2}$  m back from the edge of the shoulder.

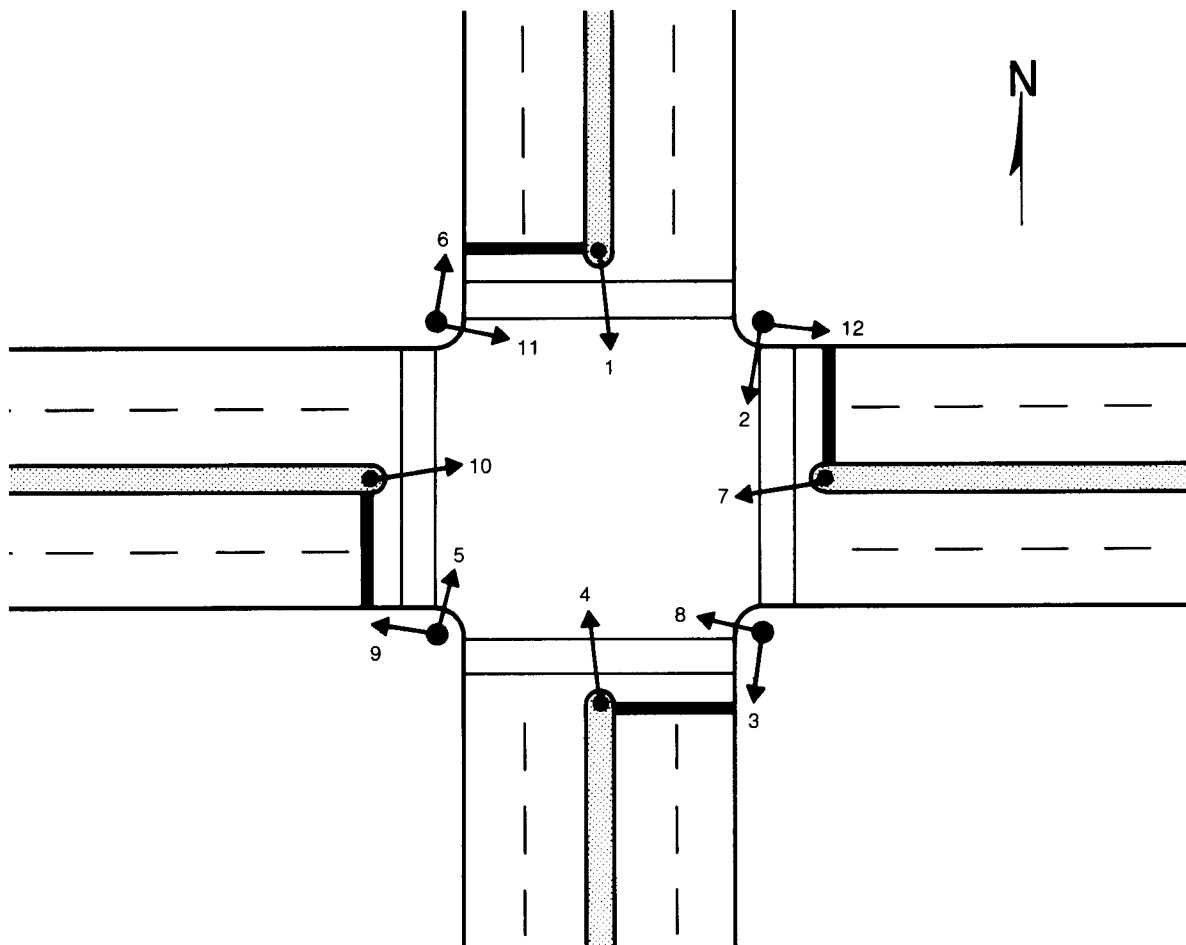
3. A signal shall not obstruct a crosswalk.

4. Supports for post-mounted signal heads shall be designed to readily break off, bend, or slip when hit by a vehicle, to minimize injury to the vehicle's occupants or damage to the vehicle. Where the speed of vehicles is less than 65 km/h and there is a vertical curb 25 cm or more in height, a "breakaway" support is not required. No part of the concrete base of a breakaway signal support shall extend more than 10 cm above the ground level at any point.

5. Vehicles shall be protected from the base of a non-breakaway (rigid) signal pole such as is used to support a signal over the roadway. Guardrail or a suitable device to deflect or stop vehicles without serious injury to the occupants shall be provided. However, this protection is not required if the support is located where it is unlikely to be hit by an out-of-control vehicle, or where the speed of vehicles is normally less than 65 km/h.

6. Each controller cabinet shall have a main door equipped with a keyed tumbler lock of the type in current use for this purpose in the Kingdom. An auxiliary door shall be mounted on the main door. This door shall

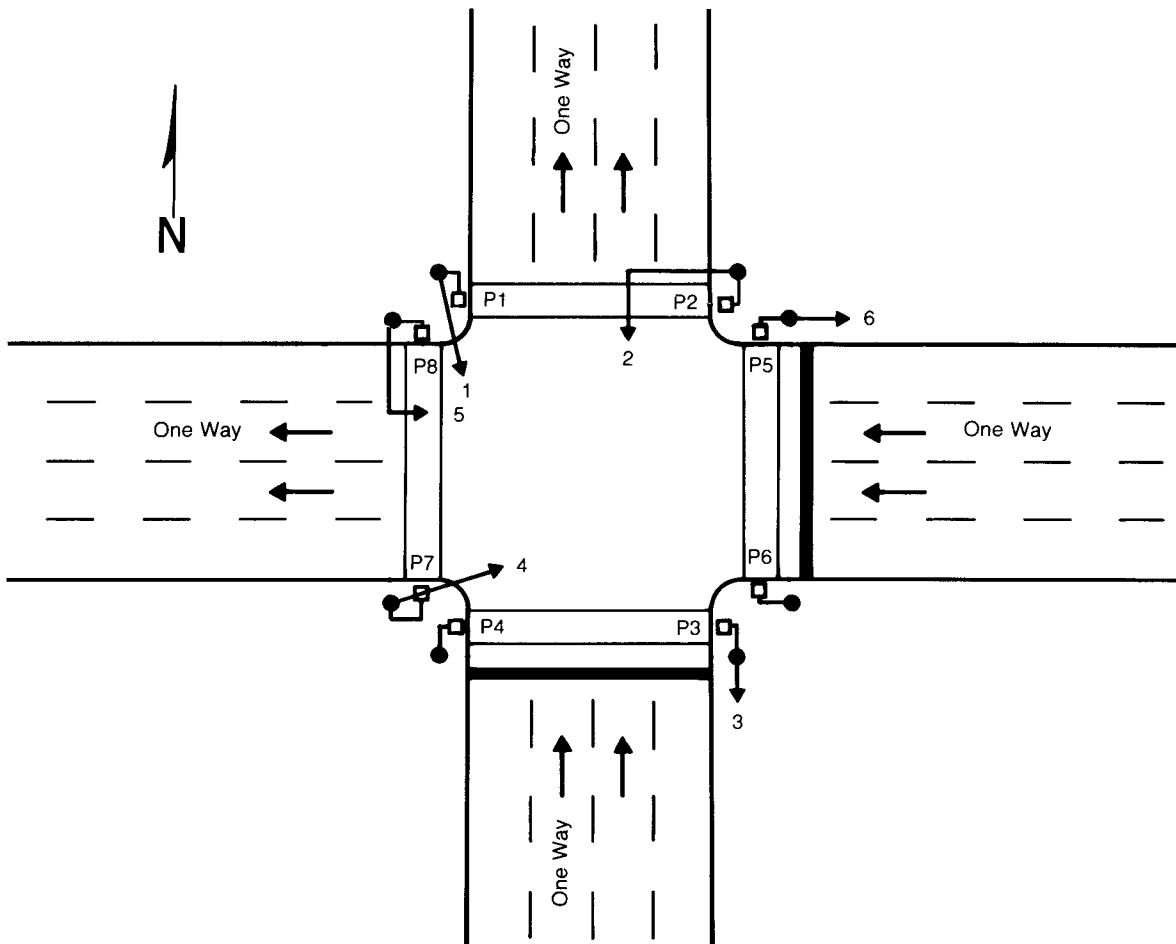
be equipped with a lock operable by a different key. The door shall give access to the manual flash, main power and controller power switches, and the manual control cord or phase change switches.



Left Turn Control	Signal Faces	Indication on Face(s)
Permissive—no Control	All	● ●
Protected/Permissive on one approach of each street (N-bound and E-bound)	1, 2, 7, 8  all other	{ ● ● ⬇ ● ●
Protected—on one or both approaches of one or both streets	Not permitted where a lane is to be used by both through traffic and left turning vehicles. During much of the green phase, vehicles waiting to turn left would prevent its use by through traffic.	

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-15**  
Signal face location and indications—divided street or highway—without pedestrian signals.

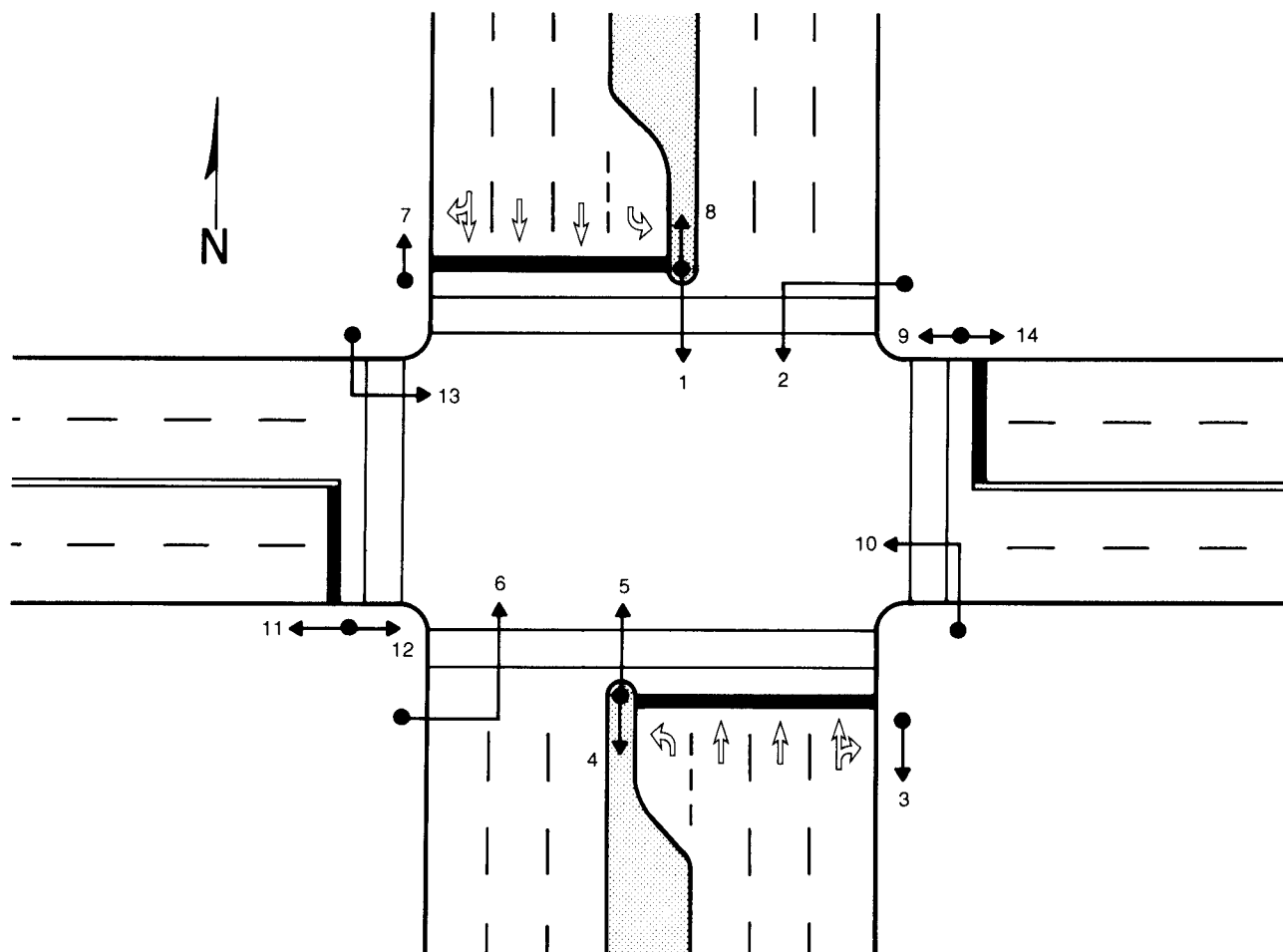


Left Turn Control	Signal Faces	Indications on Face(s)
Permissive—no Control	1 through 6  P1 through P8	
Permissive—Control for pedestrian protection only	3 and 6  2, 3, 5, 6 1, 2, 4, 5  P1 through P8	

- ● = Traffic Signals
- = Pedestrian Walk
- = Pedestrian Don't Walk
- = Pedestrian Flashing Don't Walk

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-16**  
Signal face location and indications—intersection of two one-way streets—  
with pedestrian signals.

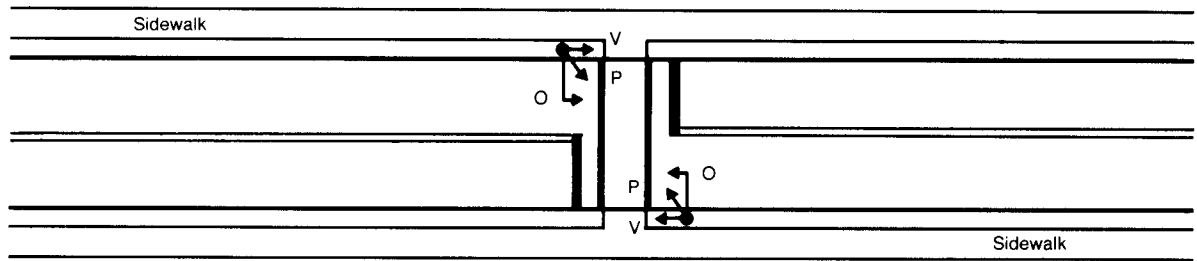


**Figure 4-17**  
**Signal face location and indications—raised median left-turn bays—without pedestrian signals.**


Left-Turn Control	Signal Faces	Indications on Face(s)
Permissive—no control	All	● ●
Protected—north bound only	1, (4 if approach is more than 11 m wide at stop line)	● (Visibility limited to Left-turn Lane) ◀
	All others	● ●
Protected—both approaches of main street	1, 5 (also 4, 8 if approach is more than 11 m wide at stop line)	● (Visibility limited to Left-turn Lane) ◀
	All others	● ●
Protected/Permissive—northbound only	1, (also 4, if approach is more than 11 m wide at stop line)	● ● (Visibility limit to Left-turn Lane) ◀
	All others	● ●
Protected/Permissive—both approaches on main street	1, 5 (also 4, 8 if approach is more than 11 m wide at stop line)	● ● (Visibility limit to Left-turn Lane) ◀
	All others	● ●

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

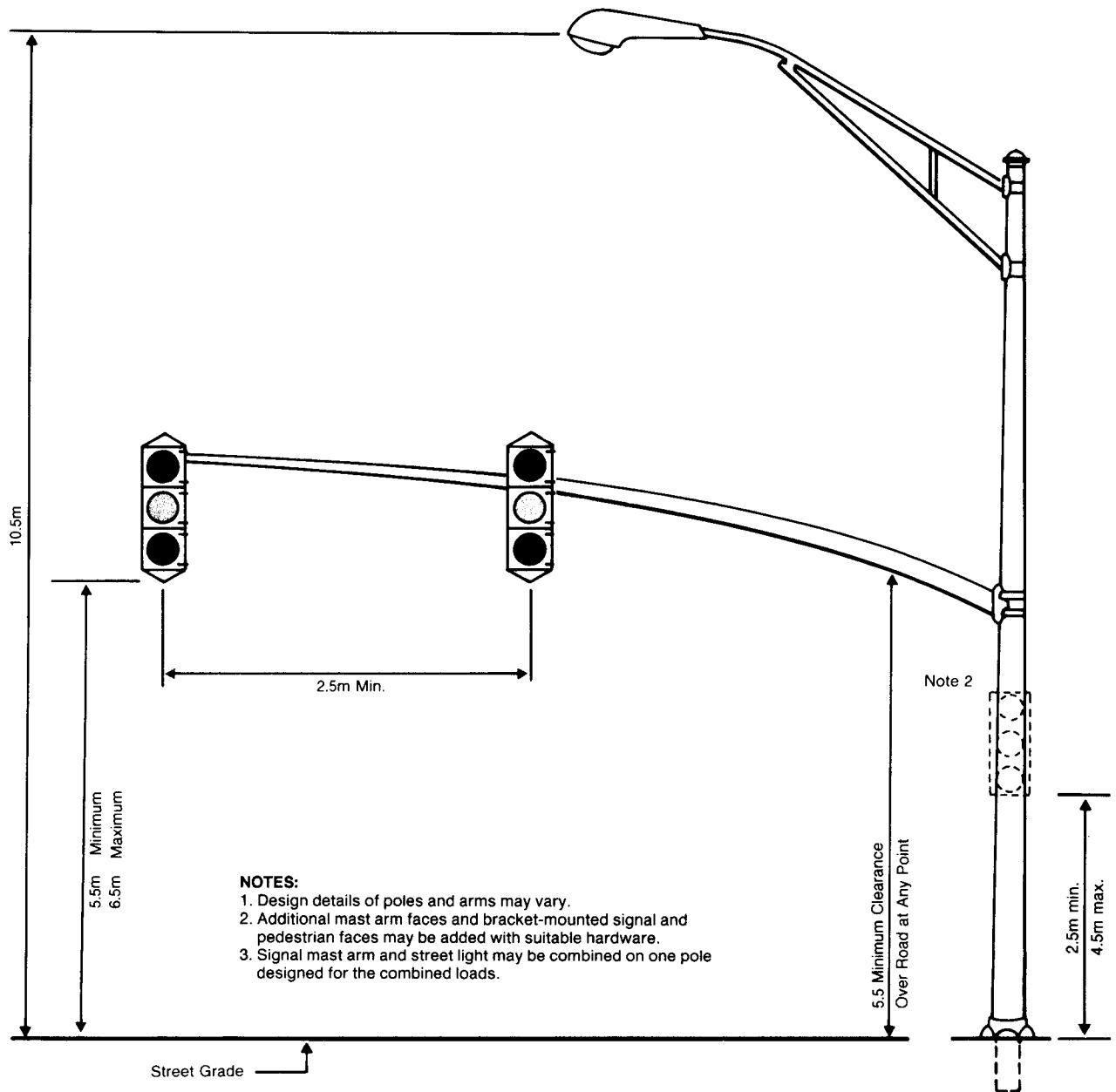
**Figure 4-17 (cont'd)**  
**Signal face location and indications—raised median left-turn bays—without pedestrian signals.**



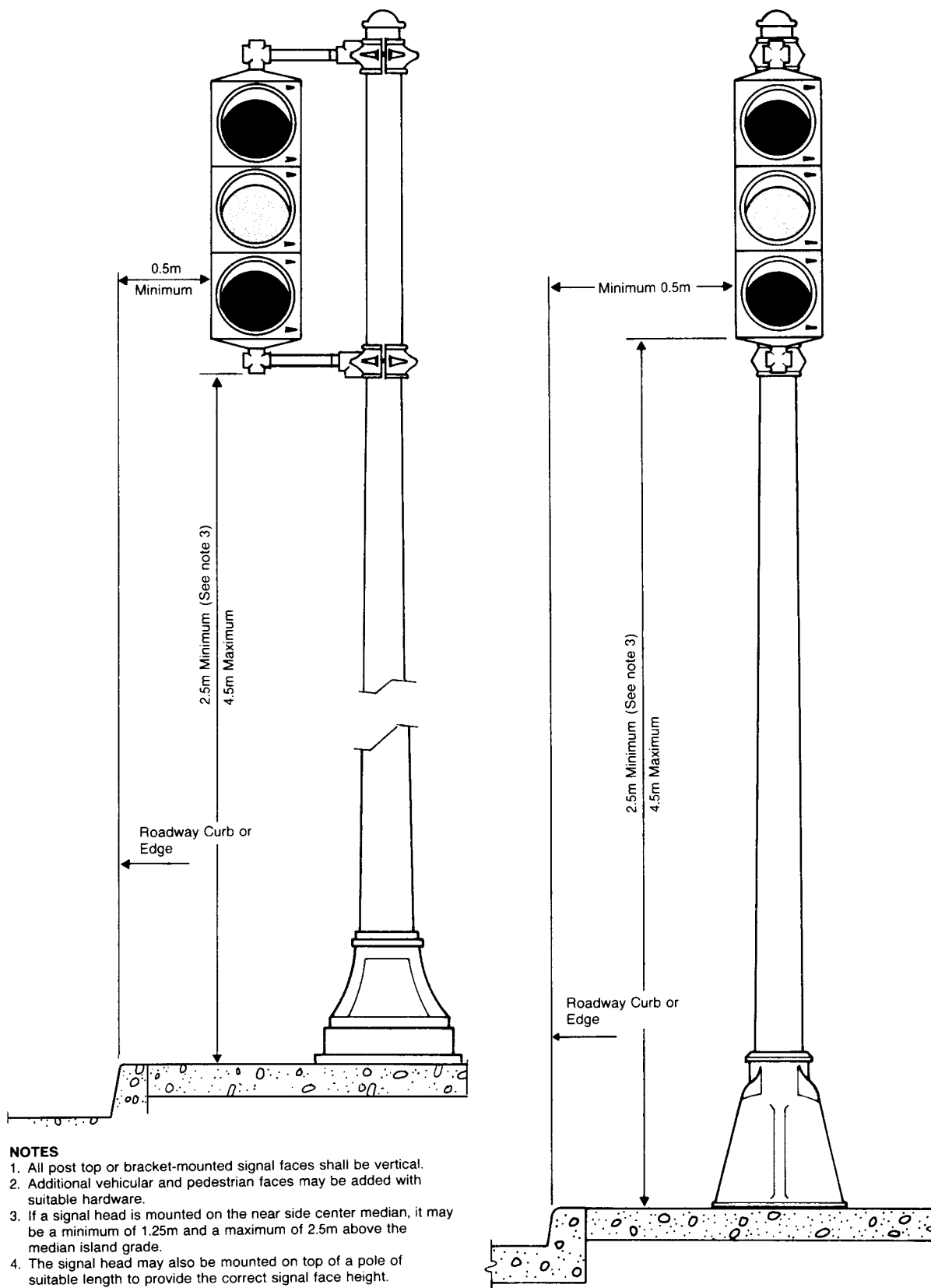
O = Signal Head Over Roadway  
V = Signal Head On Pole  
P = Pedestrian Signal Head

All vehicular signal faces have  indications

**Figure 4-18**  
Signal face location and indications—school or pedestrian midblock crossing.



**Figure 4-19**  
Typical mast arm mounting of signal heads.



**Figure 4-20**  
**Typical pedestal and short bracket signal head mountings.**

## 4.05 Traffic Control Signal Operation

### A. Vehicle Change and Clearance Intervals

1. The exclusive function of the steady yellow interval is to warn traffic that a change in the right-of-way assignment will occur. The vehicle change interval should be long enough to allow drivers approaching the indication at a legal speed to stop before entering the intersection.
2. A vehicle change interval shall be followed by a short clearance interval to allow vehicles which have entered the intersection to leave before conflicting vehicle movements enter it.
3. The length of vehicle change and clearance intervals depends on the speed and type of approaching traffic, the width of the intersected street, and the gradient (negative or positive) of the approach.
4. The vehicle change interval shall be not less than 3 seconds nor more than 7 seconds. Drivers will violate a yellow interval which is too long. Suggested change and clearance intervals are shown in Tables 4-8 and 4-9. The change and clearance intervals for a particular intersection shall be selected on the basis of its physical and traffic characteristics.

5. Change and clearance intervals shall be provided between the termination of a GREEN ARROW indication and the showing of a GREEN indication to any conflicting traffic movement. The change interval is shown by a YELLOW ARROW indication. This may be followed by a RED indication if that movement is no longer permitted. If, however, the turn is allowable on the GREEN DISK indication, clearance is provided by continuing to hold the conflicting traffic movements for a short interval (See Figure 4-23).

6. A vehicle may enter an intersection immediately before the end of the yellow change interval. It must be allowed to leave the intersection before conflicting traffic enters. This "clearance" interval may be calculated for the initial timing of the controller by using Table 4-9 or the formula:

$$T (\text{sec.}) = \frac{3.6 (W + C + L)}{V}$$

Where: W = street width in meters  
 C = distance from the stop line to the near side of the cross street  
 L = length of the vehicle  
 V = speed of vehicle in km/h

**Table 4-8**  
**Vehicle Change Interval (seconds)**

85 Percentile Approach Speed (Km/h)	Gradient on Approach								
	-8%	-6%	-4%	-2%	0	+2%	+4%	+6%	+8%
30	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
40	3.5	3.3	3.1	3.0	3.0	3.0	3.0	3.0	3.0
50	4.1	3.8	3.6	3.4	3.3	3.1	3.0	3.0	3.0
60	4.7	4.4	4.1	3.9	3.7	3.6	3.4	3.3	3.2
70	5.3	5.0	4.7	4.4	4.2	4.0	3.8	3.7	3.5
80	5.9	5.5	5.2	4.9	4.6	4.4	4.2	4.1	3.9
90	6.5	6.1	5.7	5.4	5.1	4.8	4.6	4.4	4.3
100	7.0	6.6	6.2	5.9	5.6	5.3	5.0	4.8	4.6
120	7.0c	7.0b	7.0a	6.8	6.5	6.1	5.8	5.6	5.3

$$\text{Vehicle Change Interval (Sec.)} = t + \frac{0.91V}{6.56A + 0.644G}$$

Where A = 3.048 (deceleration rate m/s<sup>2</sup>)  
 t = 1.0 sec. (reaction time)  
 G = Gradient on Approach (%)  
 V = Speed of Vehicle in Km/h

Notes: a. Add 0.3 seconds to clearance interval shown in last column of Table 4-9. (When approach gradient is -4%)  
 b. Add 0.8 seconds to clearance interval shown in last column of Table 4-9. (When approach gradient is -6%)  
 c. Add 1.4 seconds to clearance interval shown in last column of Table 4-9. (When approach gradient is -8%)

**Table 4-9**  
**Vehicle Clearance Interval (Seconds)**

Cross Street Width (Meters)	85 Percentile Vehicle Approach Speed-Km/h										
	30	40	50	60	70	80	90	100	110	120*	
9	2.5	1.9	1.5	1.3	1.1	0.9	0.8	0.8	0.7	0.6	
12	2.9	2.2	1.7	1.4	1.2	1.1	1.0	0.9	0.8	0.7	
15	3.2	2.4	1.9	1.6	1.4	1.2	1.1	1.0	0.9	0.8	
18	3.6	2.7	2.2	1.8	1.5	1.4	1.2	1.1	1.0	0.9	
21	4.0	3.0	2.4	2.0	1.7	1.5	1.3	1.2	1.1	1.0	
25	4.4	3.3	2.7	2.2	1.9	1.7	1.5	1.3	1.2	1.1	
28	4.8	3.6	2.9	2.4	2.1	1.8	1.6	1.4	1.3	1.2	
31	5.2	3.8	3.1	2.6	2.2	1.9	1.7	1.5	1.4	1.3	
34	5.5	4.1	3.3	2.8	2.4	2.1	1.8	1.7	1.5	1.4	
37	5.9	4.4	3.5	2.9	2.5	2.2	2.0	1.8	1.6	1.5	
40	6.2	4.7	3.7	3.1	2.7	2.3	2.1	1.9	1.7	1.6	
43	6.6	5.0	4.0	3.3	2.8	2.5	2.2	2.0	1.8	1.7	
46	7.0	5.2	4.2	3.5	3.0	2.6	2.3	2.1	1.9	1.8	
55	8.0	6.0	4.8	4.0	3.4	3.0	2.7	2.4	2.2	2.0	
60	8.6	6.5	5.2	4.3	3.7	3.2	2.9	2.6	2.4	2.2	

$$\text{Vehicle Clearance Interval} = \frac{3.6 (W + C + L)}{V}$$

When W = Width of cross street (meters)

C = Assumed Distance from stop line to the near side cross street curb (3m)

L = Assumed vehicle length (9m)

V = Vehicle Speed (Km/h)

\*Add the following values to the Vehicle Clearance Intervals when the approach gradient is

-4% add 0.3 seconds

-6% add 0.8 seconds

-8% add 1.4 seconds

After the signal is functioning, it should be adjusted for actual operating conditions. The length of the interval can frequently be shorter than initially calculated.

## **B. Prevention of Unexpected Traffic Conflicts**

1. Signal indications, allowing unexpected crossing or merging of the paths of vehicles with the paths of other vehicles and pedestrians, shall not be given except when all of the following three conditions exist:

- a. The crossing or merging involves only slight hazard, and
- b. Serious traffic delays can be materially reduced.
- c. Drivers and pedestrians making the conflicting movements are effectively warned of the conflicts.

2. Warning may be given by signs or the use of an appropriate traffic signal indication.

3. A LEFT GREEN ARROW signal indication shall not be shown when drivers obeying it would intersect the path of pedestrians crossing in response to a Walk indication.

## **C. Protective Fail-Safe Circuitry**

Traffic signal controllers installed after issuance of this Manual shall, through internal or external electrical circuitry, determine if green signal indications are being given to conflicting traffic movements. If such indications are being given, the signal shall immediately be transferred to the flashing mode described in paragraph 4.05 F 7. The signal shall stay in this mode until the fault is corrected, and the signal is manually restored to normal operation.

## **D. Sequence of Traffic Control Signal Indications (Operating Plans)**

1. The safe and efficient operation of a signalized intersection is dependent upon providing the best sequence and timing of signal intervals and phases.

2. A pretimed signal controller or system generally does not change the sequence in which indications or phases occur. However, in traffic-actuated controllers and traffic-adjusted signal systems, both the sequence and timing of intervals and phases can change each cycle. Whether or not the sequences change frequently, they must be planned and controlled to prevent unsafe and conflicting indications and movements.

3. Every controller or control system shall be designed and operated for safe and efficient functioning. In the normal operation of a traffic control signal, the indications on a

specific signal face shall be followed by one of the approved indications or combinations of indications given in Table 4-5. No unauthorized "following" indications may be shown. The authorized indication progression in the case where the operation of a traffic control signal is preempted by a train or emergency vehicle may be taken from either Table 4-5 or Table 4-6.

4. A signal installation shall comply with the following requirements:

a. An arrow indication shall never direct vehicles across the path of pedestrians who have a Walk indication.

b. When a green vehicular indication or a pedestrian Walk indication is terminated, it shall be followed by a change and a clearance interval.

c. If a GREEN DISK indication is to continue when a GREEN ARROW indication begins, (called a lagging left turn), opposing or conflicting vehicular movements shall first be stopped. This shall be done by displaying a yellow change indication followed by a red clearance indication for the conflicting movements. The GREEN ARROW indication may be shown.

d. A signal indication sequence may allow a left turn to be made only on a GREEN ARROW. Such a sequence shall be used only when left turning vehicles have a lane separate from and in addition to lanes for through traffic.

e. "Protected" turning movements are allowed by GREEN ARROW indications shown when other traffic movements do not conflict with the turning movements. It is easier for drivers to turn left when they are protected by the signal from conflicting movements than when they are not protected. However, protected turns frequently reduce the efficiency and capacity of an intersection. Therefore, signal operating plans should provide for protected turning movements only at intersections where the left turn volume is large or where left turn accidents have been frequent.

5. Many sequences of signal phases are possible. The sequence of phases sometimes affects the sequence of indications within a phase. The most commonly used sequences of signal phases and indications (operating plans) are given in the following paragraphs. If an engineering study shows a different phase sequence is desirable, that sequence shall comply with all standards herein.

a. The standard four phase traffic signal is

shown in Figure 4-21.

b. The standard sequence of traffic signal indications and phases is shown in Figure 4-22. Figure 4-22 also shows the standard numbering for traffic signal indications. It shall be used whenever practicable. It is particularly applicable to the intersection of two streets where all drivers who wish to turn left can do so within two signal cycles. The standard sequence which includes pedestrian signal indications is shown in Figure 4-23.

c. A left turn movement may be "permissive," "protected/permissive," or "protected/prohibited." A permissive left turn is one which may be made whenever a GREEN DISK is displayed (unless prohibited by a regulatory sign). In a protected/permissive left turn, the GREEN ARROW indication is displayed with the GREEN DISK indication. This tells motorists no oncoming traffic from the opposite direction (or other movements) will conflict with turning traffic during the GREEN ARROW left turn phase. However, during the display of the GREEN DISK indication alone without the GREEN ARROW, vehicles turning left must yield the right-of-way to vehicles entering from the opposite approach on the GREEN indication. The term "protected/prohibited" also means no movements will conflict with turning traffic during the GREEN ARROW phase. However, left turns are prohibited when the GREEN ARROW indication is not being shown to that approach. The GREEN ARROW indication may be displayed with or independent of the GREEN DISK indication for a protected/permissive left turn.

d. A left turn movement may be allowed to take place throughout the green phase (permissive phasing), at the beginning or at the end of the green phase. When allowed at the beginning of the green phase, it is called a leading left turn interval. When allowed at the end of the green phase it is called a lagging left turn interval.

e. A leading left turn is usually preferable to a lagging left turn because the risk of accidents is less when the turn is leading. Before a leading left turn begins, all traffic is stopped because the cross street green phase has terminated. Therefore, there are no conflicting movements, and the likelihood of accidents involving the vehicles turning on the leading GREEN ARROW decreases. A lagging left turn from only one approach usually is accompanied by a

GREEN DISK on the same approach. Traffic on the opposite approach, (which has a RED DISK indication) may not stop because it is watching other traffic. Generally, a lagging left turn should be simultaneous on both opposite approaches with both through movements being stopped.

f. A left turn movement from a street may be allowed from only one of its approaches to the intersection or from opposite approaches simultaneously. The latter is called a two-direction simultaneous left turn. Straight through and right turning vehicles should be prohibited from entering the intersection at this time.

g. When Walk and Don't Walk indications are used, the GREEN ARROW interval must be coordinated with the pedestrian indications (See Section 4.05 B 3).

h. The signal operating plans for several typical intersection designs are illustrated in the following figures:

Leading Protected/  
Permissive Left Turn From  
One Approach

Figure 4-24

Permissive Left Turn on  
GREEN DISK from Opposite  
Approaches

Figure 4-25

Leading Protected/  
Permissive Left Turn from  
Opposite Approaches

Figure 4-26

Leading Protected/  
Prohibited Left Turn from  
One Approach Intersection  
with One-Way Street

Figure 4-27

Intersection of Two  
Divided Streets with  
Service Roads

Figure 4-28

Intersection of Two  
Divided Highways Having  
Left-Turn Bays in the  
Median

Figure 4-29

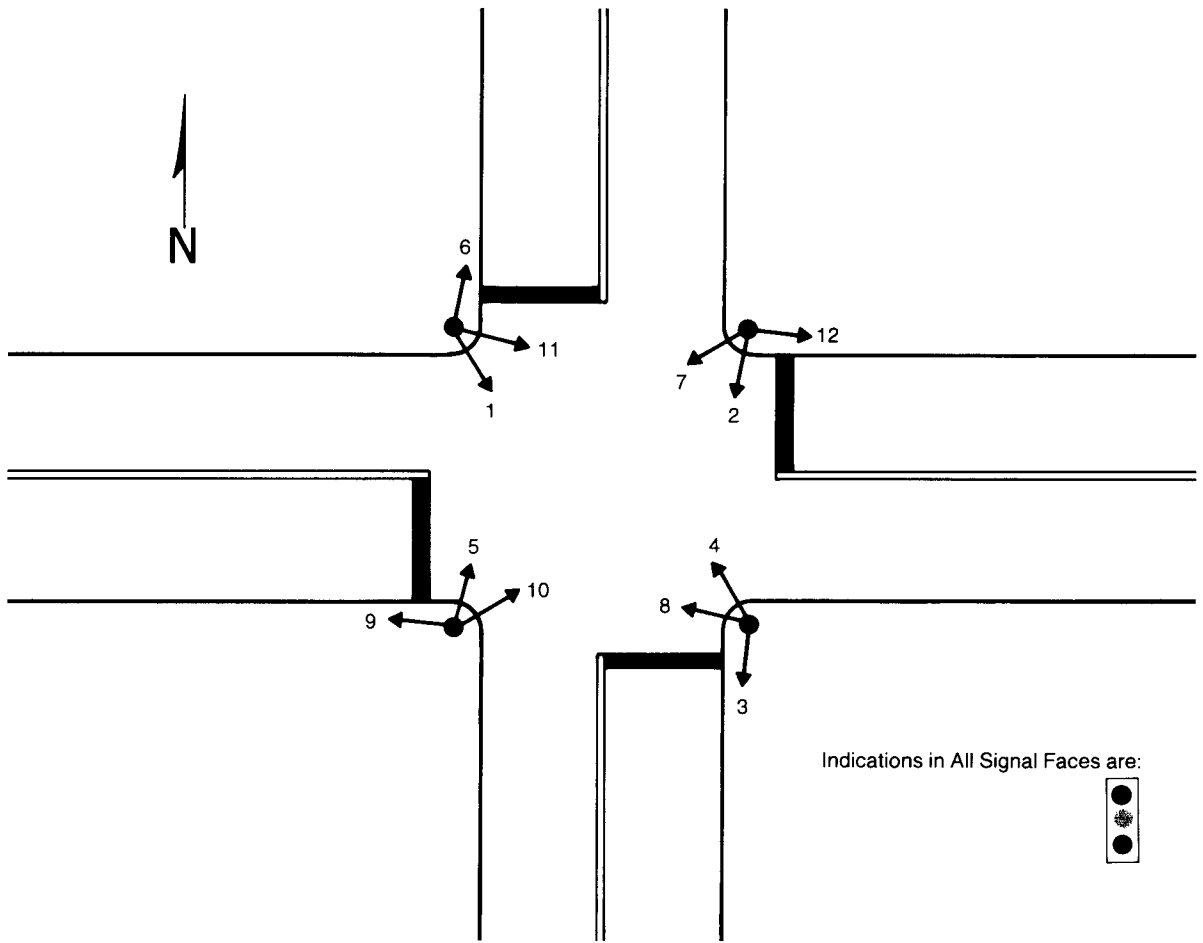
"T" Intersection with a  
Service Road Along the  
Principal Street

Figure 4-30

"T" Intersection with a Left-  
Turn Bay Continuous  
Traffic on the Principal  
Street

Figure 4-31

i. Right turns normally involve considerably less potential conflict than left turns. Also, right turn intervals seldom are needed. The same general principles may be applied to right turns as to left turns in those cases where a right turn interval is required.

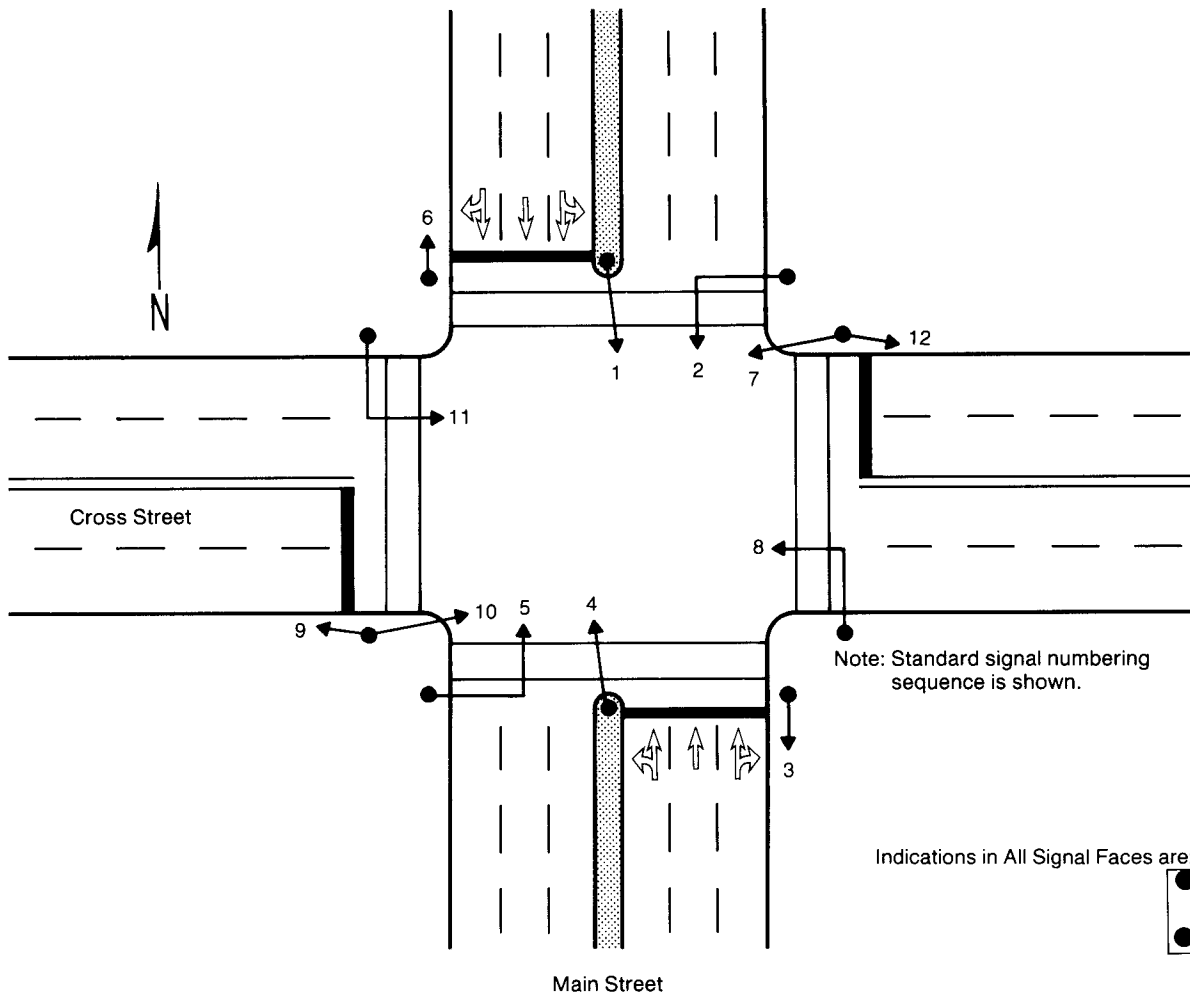


Sequence of Signal Indications Using a Pretimed Controller













Phases	Intervals	Approache				Movements
		NB 1,2,3	SB 4,5,6	EB 7,8,9	WB 10,11,12	
A	1	●	●	●	●	↓      ↓
	2	●	●	●	●	↓      ↓
	3	●	●	●	●	↓      ↓
B	1	●	●	●	●	↓      ↓
	2	●	●	●	●	↓      ↓
	3	●	●	●	●	↓      ↓
C	1	●	●	●	●	↓      ↓
	2	●	●	●	●	↓      ↓
	3	●	●	●	●	↓      ↓
D	1	●	●	●	●	↓      ↓
	2	●	●	●	●	↓      ↓
	3	●	●	●	●	↓      ↓

REPEAT

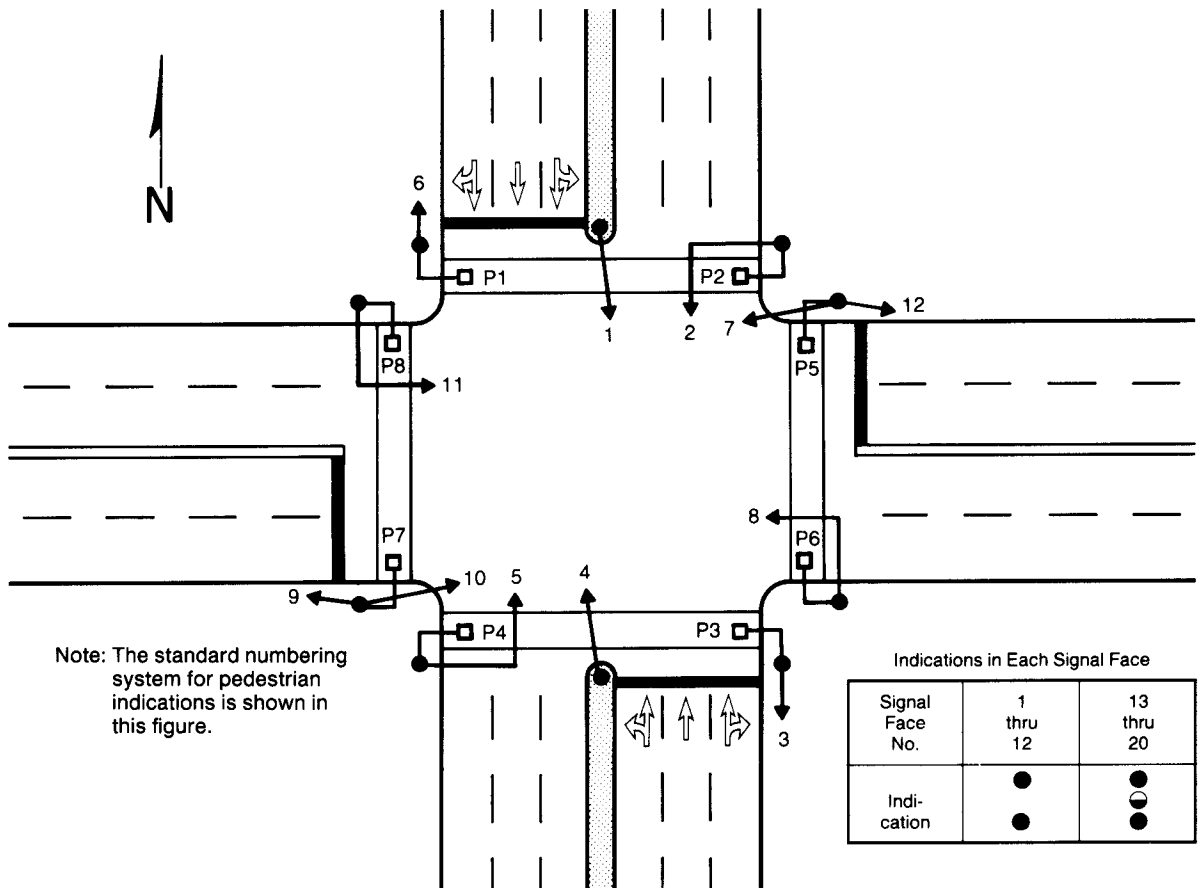
Figure 4-21  
Standard four phase traffic signal—without pedestrian signals.



**Sequence of Signal Indications Using a Pretimed Controller**

Signal Face No.		1 thru 6 Main Street	7 thru 12 Cross Street	Movements
Phase	Interval			
A	1	●	●	 
	2		●	 
	3	●	●	 
B	4	●	●	 
	5	●		 
	6	●	●	 

**Figure 4-22**  
Signal operating plan No. 1—standard signal operating plan—without pedestrian signals.



Sequence of Signal Indications Using a Pretimed Controller

Direction		Northbound		Southbound		Eastbound		Westbound		Movements
Signal Face		Veh. 1,2,3	Ped. P1,P2	Veh. 4,5,6	Ped. P3,P4	Veh. 7,8,9	Ped. P5,P6	Veh. 10,11,12	Ped. P7,P8	
Phase	Interval									
A	1	●	●	●	●	●	◐	●	◐	
	2	●	●	●	●	●	●	●	●	
	3		●		●	●	●	●	●	
	4	●	●	●	●	●	●	●	●	
B	5	●	◐	●	◐	●	●	●	●	
	6	●	●	●	●	●	●	●	●	
	7	●	●	●	●		●		●	
	8	●	●	●	●	●	●	●	●	

(For Symbol code see Figure 4-16)

Figure 4-23  
Signal operating plan No. 2—standard signal operating plan including pedestrian indications—  
with pedestrian signals.

j. Pretimed signal controllers and systems shall be designed to provide interval and phase sequences which meet the requirements of this section. The newest types of controllers and systems, based upon solid state (semiconductor) technology, have great flexibility in the timing and sequence of intervals and phases. In the case of pretimed equipment, operation may be specified by detailing all indications in proper sequence.

k. Figure 4-22 illustrates one manner in which the sequence of signal phases, intervals and indications may be shown. This method is particularly satisfactory for pretimed signals in which the sequence of phases does not change.

l. Figures 4-32 and 4-33 illustrate a manner in which the desired operation of a traffic-actuated signal may be shown. Modern traffic-actuated controllers may be designed and operated by traffic demand to vary the lengths of intervals and change the sequences in which the intervals occur.

Figure 4-32 Part A shows a simple intersection of two streets, each with a curbed median and left-turn bays. Vehicle detector loops and signal faces are shown, as well as pedestrian signal faces. Left turns from north to east and from south to west may occur only on the GREEN ARROW indication (protected/prohibited left turns). Left turns from east to south and from west to north may occur both on the appropriate GREEN ARROW and on the GREEN DISK indication on those approaches (protected/permissive left turns). Some of the explanatory notes in Part C of Figure 4-33 also apply to Figure 4-32.

Figure 4-32 Part B is a diagram of the eight phases (each interval is considered to be a phase) in the signal sequence. Through and left turn movements are given separate phases. It is assumed right turns may be made on the GREEN DISK indication.

Figure 4-33 has three parts:

(1) Part A is a table showing for each phase the other phases (nonconflicting phases) which could simultaneously be shown with it and the phases (called conflicting phases) which would have movements in conflict with the phase having the green indication.

More than one phase (for example Phases 1 and 5, or 3 and 8) may occur simultaneously, if the appropriate

detectors are actuated.

However, phases occurring simultaneously must be on the same side of the "barrier line." Also, no more than two phases per ring may occur simultaneously. Exceptions to these limitations occur when "overlapping" phases are present, but the complexity of this phasing requires more space than is available in this Manual. The terms "ring" and "barrier" come from the characteristics of the solid state circuitry used in these controllers.

(2) Part B is a table showing the signal indications used in the change and clearance intervals following each phase. This table must be read with the notes in Part C.

(3) Part C contains notes needed to explain and amplify Figures 4-32 and 4-33.

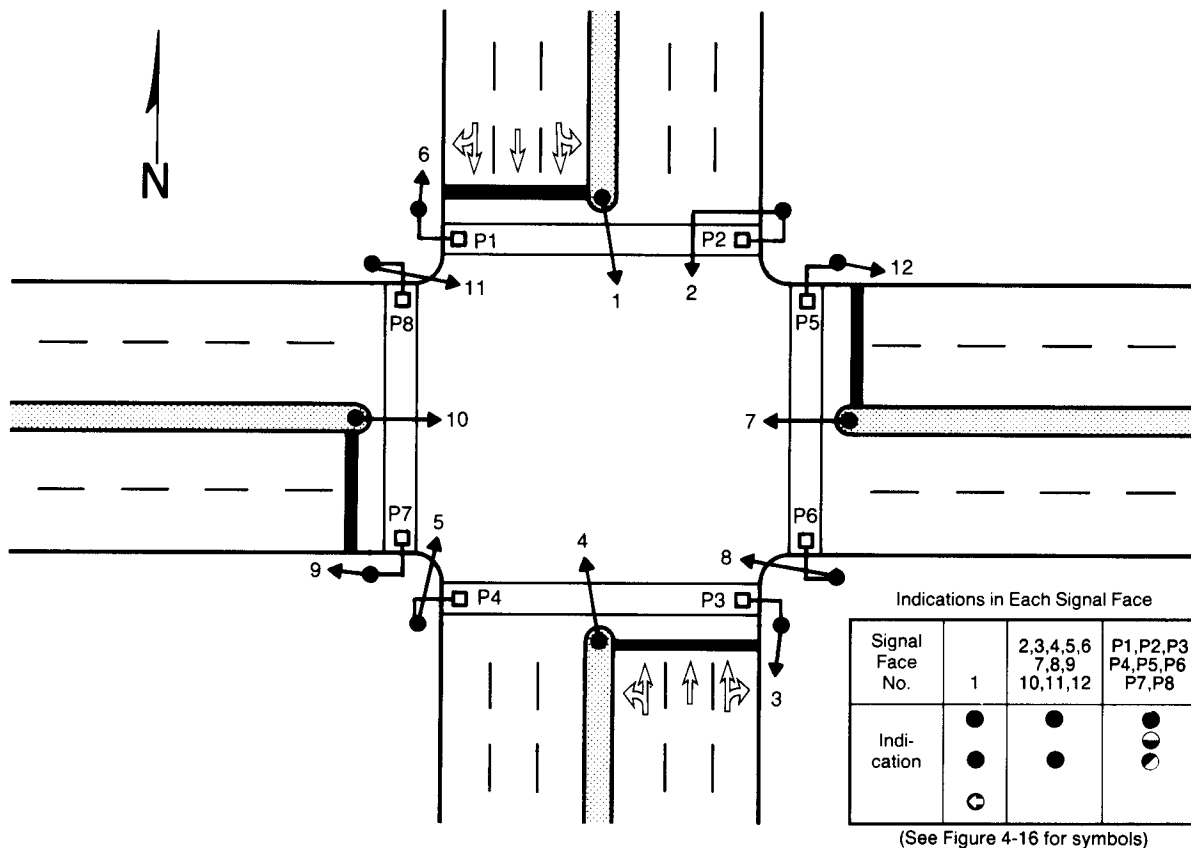
6. The signalization of the intersection of the ramps and the crossroad at a diamond interchange is a special case. Several standard types of phase sequences are used. Some of the most useful of these are shown in Figures 4-34 to 4-37. Traffic estimates shall be made prior to signalization, and the most appropriate phase sequence shall be adopted initially. Studies shall be made after signalization, and one of the other phase sequences shall be used if better results could be obtained with it.

## E. Coordination of Traffic Control Signals

1. Both pretimed and traffic-actuated signals within 800 m of one another along a major route or in a network of major routes shall normally be operated in coordination to minimize unnecessary delay and accidents.

2. Coordination may be accomplished by wires between the signal controllers in the system, with one controller (or a central master controller) designed to send impulses at intervals to regulate the operation of the other controllers. As a temporary measure, pretimed signals may be coordinated by using a common cycle length and setting the time relationships (offsets) by stop watch. Coordination usually cannot be maintained across boundaries between signal systems which operate on different cycle lengths.

3. A time-base coordination unit at each controller may be used for coordinating traffic control signals. No wires are needed between controllers. The time-base coordinator is essentially an accurate and stable clock which may be independent of the power



**Sequence of Signal Indications Using a Pretimed Controller**

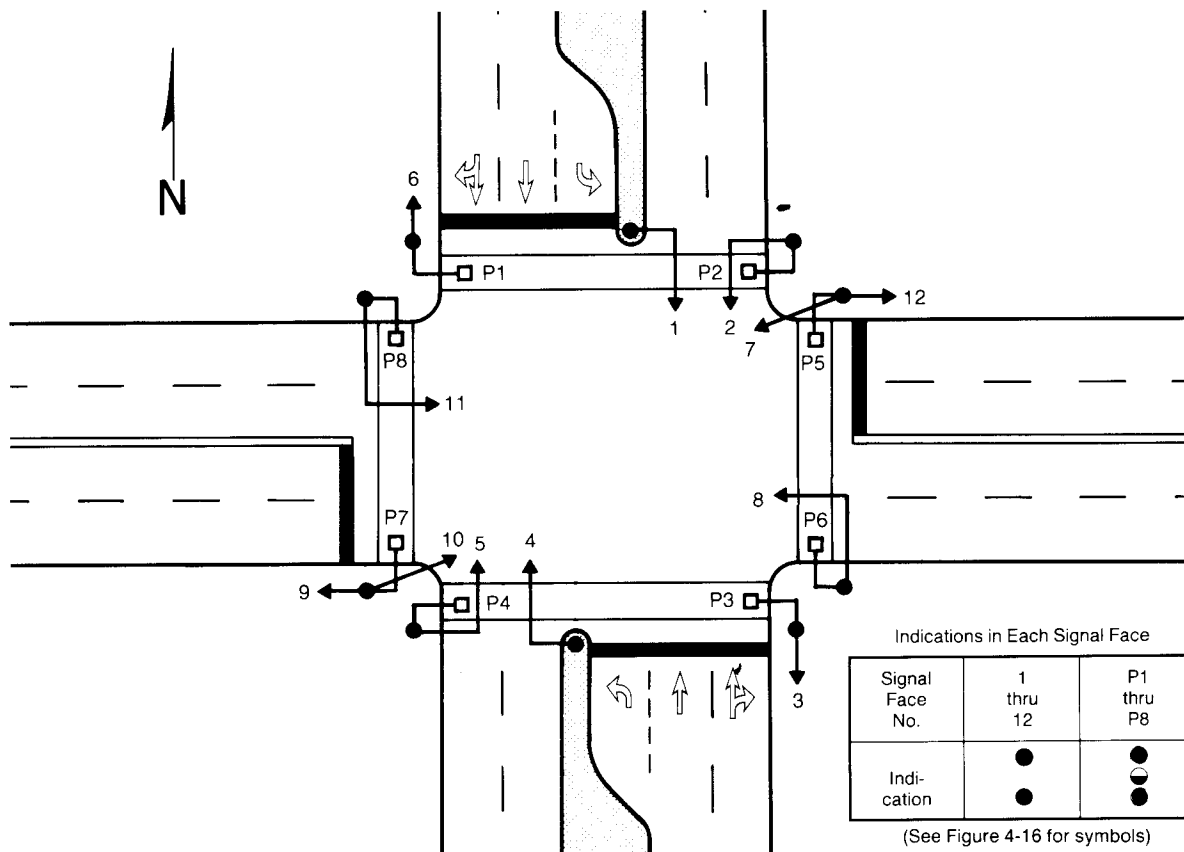
Direction		Northbound		Southbound		Eastbound		Westbound		Movements	
Signal Face		Veh. 4,5,6	Ped. P1,2	Veh. 1, 2, 3		Ped. P3,4	Veh. 10,11,12	Ped. P5,6	Veh. 7,8,9		Ped. P7,8
Phase	Interval										
A	1	●	●	⬅●	●	●	●	◐	●	●	
	2	●	●	●	●	●	●	◐	●	●	
	3	●	●	●	●	●	●	◐	●	●	
	4	●	●	●	●	●	●	◐	●	◐	
	5	●	●	●	●	●	●	●	●	●	
	6		●			●	●	●	●	●	
	7	●	●	●	●	●	●	●	●	●	
B	8	●	◐	●	●	◐	●	●	●	●	
	9	●	●	●	●	●	●	●	●	●	
	10	●	●	●	●	●		●		●	
	11	●	●	●	●	●	●	●	●	●	

REPEAT

Note: If pedestrian signal indications and intervals are not required, intervals 5 and 9 shall be omitted.

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-24**  
Signal operating plan No. 3—leading protected/permmissive left turn from one approach—  
with pedestrian signals.



**Sequence of Signal Indications Using a Pretimed Controller**

Direction		Northbound		Southbound		Eastbound		Westbound		Movements
Signal Face		Veh. 1,2,3	Ped. P1,2	Veh. 4,5,6	Ped. P3,4	Veh. 7,8,9	Ped. P5,6	Veh. 10,11,12	Ped. P7,8	
Phase	Interval									
A	1	●	●	●	●	●	●	●	●	
	2	●	●	●	●	●	●	●	●	
	3		●		●	●	●	●	●	
	4	●	●	●	●	●	●	●	●	
B	5	●	●	●	●	●	●	●	●	
	6	●	●	●	●	●	●	●	●	
	7	●	●	●	●	●	●	●	●	
	8	●	●	●	●	●	●	●	●	

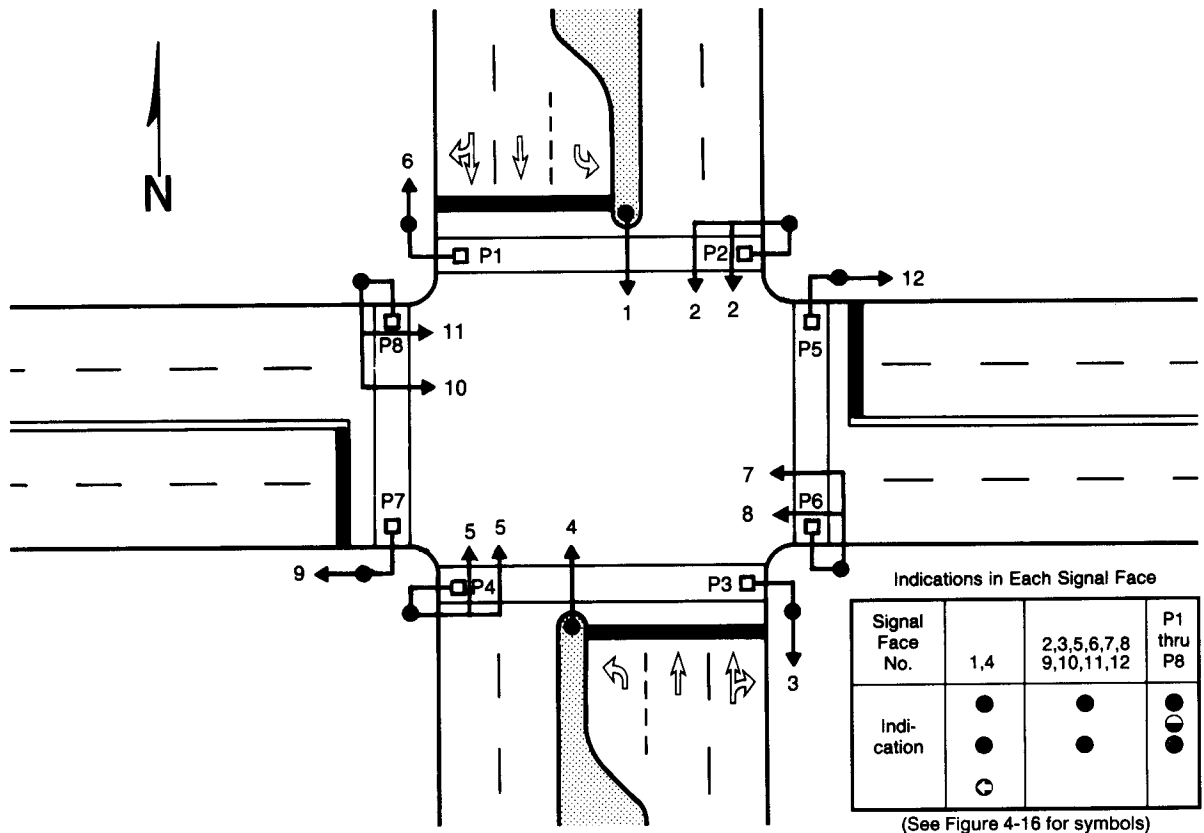
REPEAT

Note: If pedestrian signal indications and intervals are not required, intervals 2 and 6 shall be omitted.











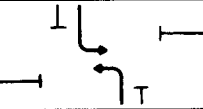




















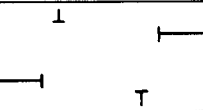




















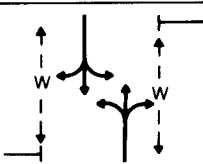

















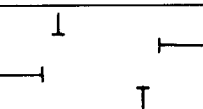










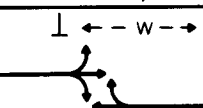




















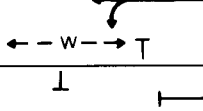










Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-25**

**Signal operating plan No. 4—permissive left turn on green disk from opposite approaches—  
with pedestrian signals.**



**Sequence of Signal Indications Using a Pretimed Controller**

Direction		Northbound		Southbound		Eastbound		Westbound		Movements		
Signal Face No.	Phase Interval No.	Veh. 1,2,3	Ped. P1,2	Veh. 4,5,6	Ped. P3,4	Veh. 7,8,9	Ped. P5,6	Veh. 10,11,12	Ped. P7,8			
A	1											
	2											
	3											
	4											
	5											
	6											
	7											
B	8											
	9											
	10											
	11											

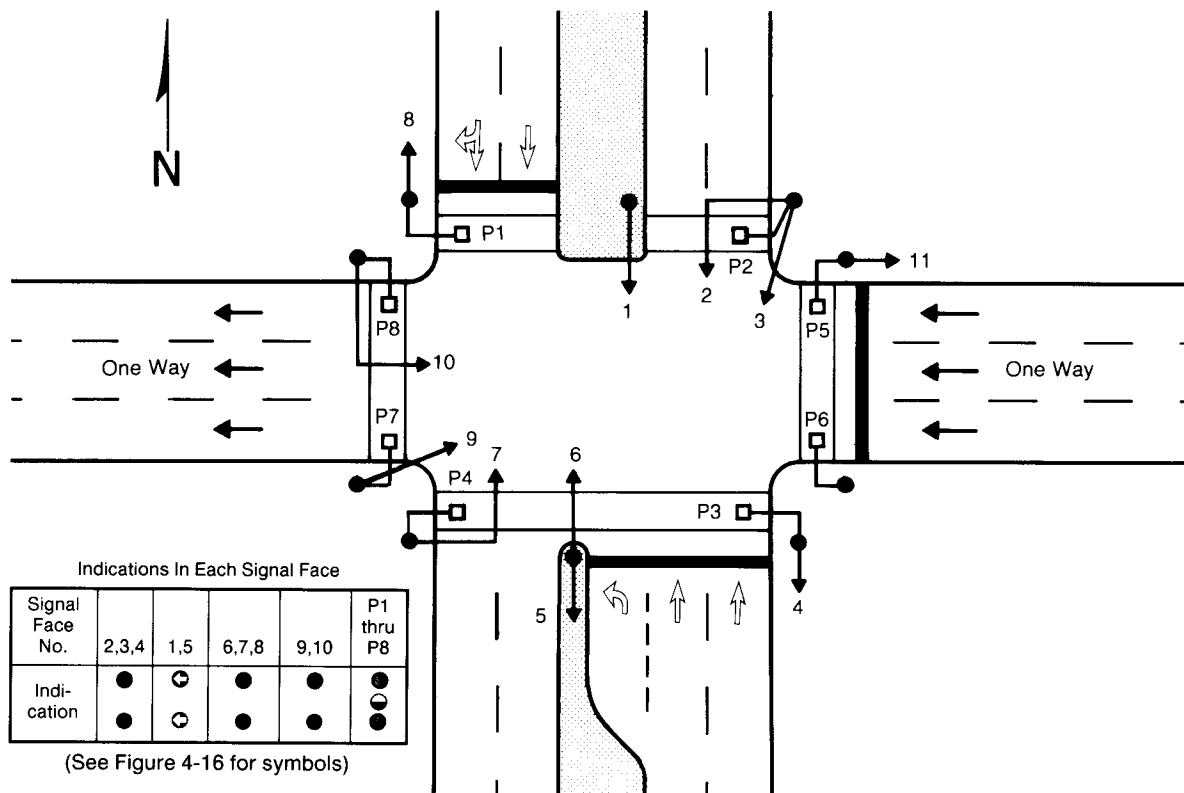
**REPEAT**

Note: If pedestrian signal indications and intervals are not required, intervals 5 and 9 shall be omitted.

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-26**

**Signal operating plan No. 5—leading protected/permissive left turn from opposite approaches—with pedestrian signals.**



Sequence of Signal Indications Using a Pretimed Controller

Direction		Northbound			Southbound		Eastbound		Westbound		Movements
Signal Face No.		Veh. 1,5	Veh. 2,3,4	Ped. P1,P2	Veh. 6,7,8	Ped. P3,P4	Veh. P5,P6	Ped. P5,P6	Veh. 9,10,11	Ped. P7,P8	
Phase	Interval No.										
A	1	⊙	●	●	●	●	None	●	●	●	⊥
	2		●	●	●	●	None	●	●	●	⊥
	3	⊙	●	●	●	●	None	●	●	●	⊥
	4	⊙	●	●	●	●	None	●	●	●	⊥
	5	⊙	●	●	●	●	None	●	●	●	⊥
	6	⊙		●		●	None	●	●	●	⊥
	7	⊙	●	●	●	●	None	●	●	●	⊥
B	8	⊙	●	●	●	●	None	●	●	●	⊥
	9	⊙	●	●	●	●	None	●	●	●	⊥
	10	⊙	●	●	●	●	None	●		●	⊥
	11	⊙	●	●	●	●	None	●	●	●	⊥

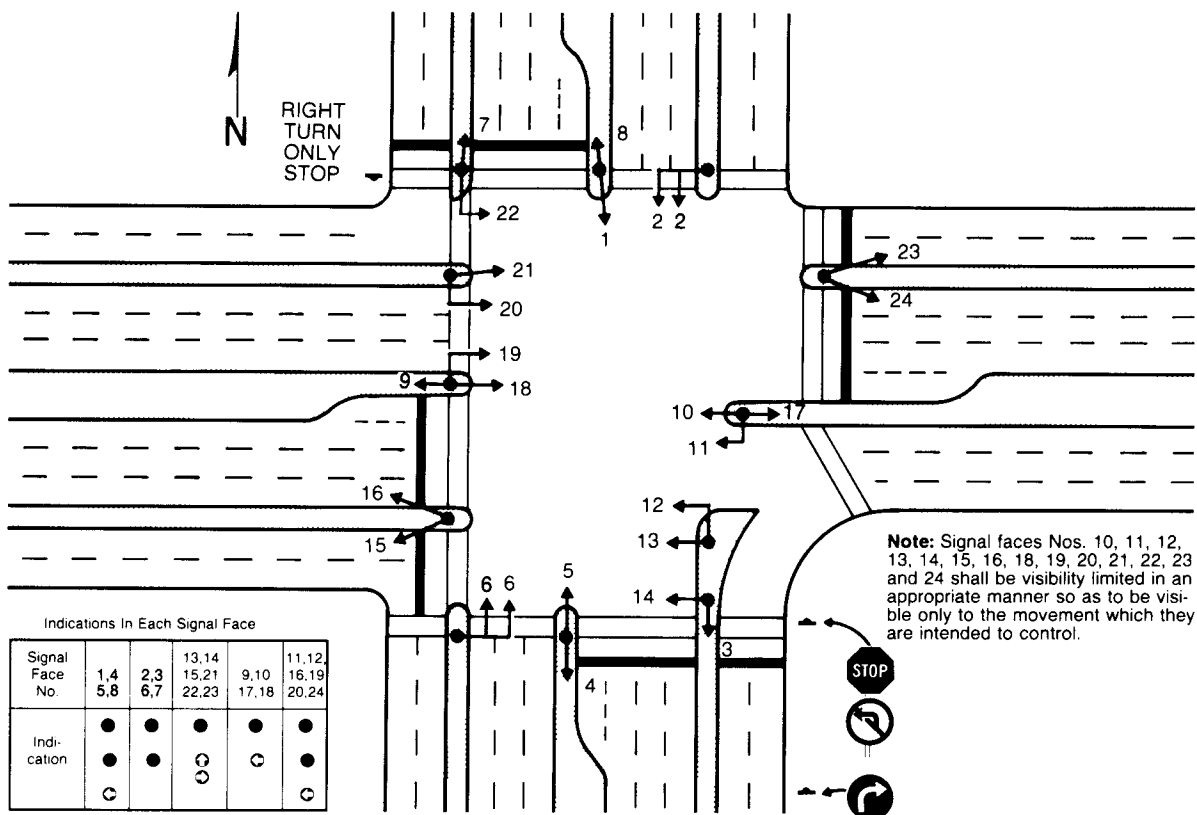
REPEAT

Note: If pedestrian signal indications and intervals are not required, intervals 5 and 9 shall be omitted.

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

Figure 4-27

Signal operating plan No. 6—leading protected/prohibited left turn from one approach intersection with one-way street—with pedestrian signals.



Indications in Each Signal Face					
Signal Face No.	1,4 5,8	2,3 6,7	13,14 15,21 22,23	9,10 17,18	11,12 16,19 20,24
Indi- cation	● ● C	● ● C	● ● C	● ● C	● ● C

### Sequence of Signal Indications Using a Pretimed Controller

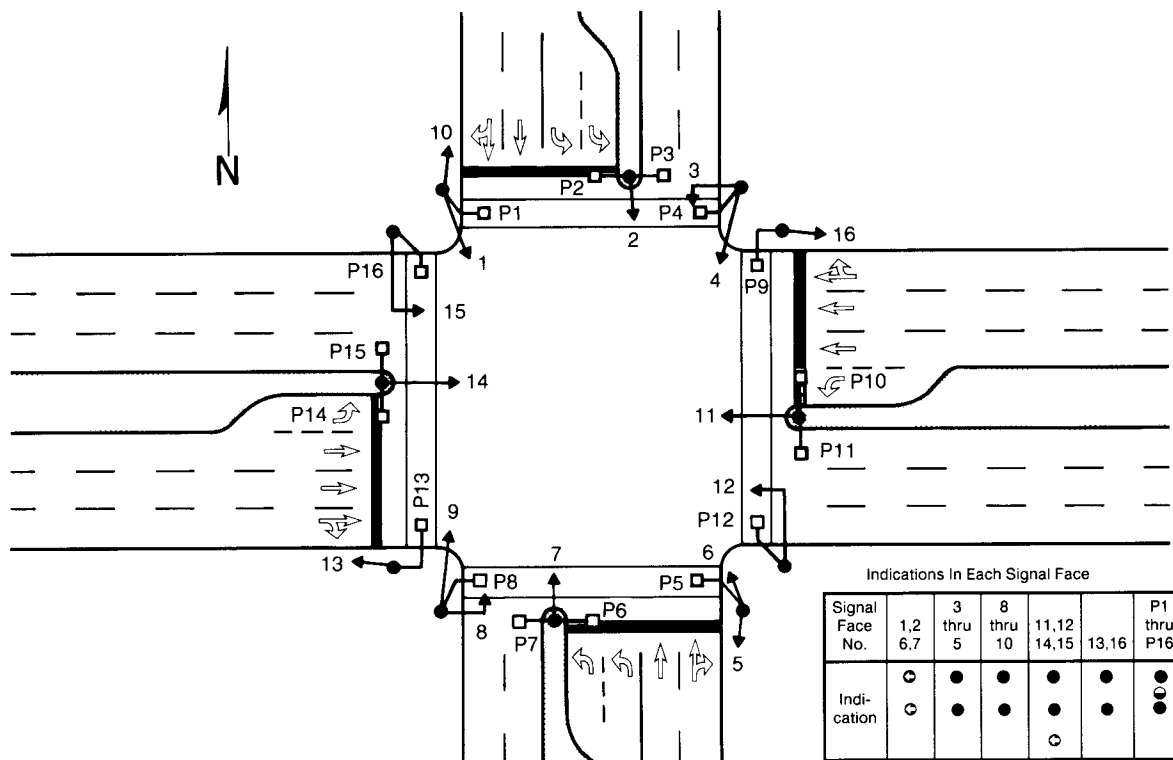
Direction		Northbound		Southbound		Eastbound			Westbound			Movements
Signal Face No.		1,4	2,3	5,8	6,7	15,13, 14	9,10	11,12 16	21,22 23	17,18	19,20, 24	
Phase	Int. No.											
A	1											
	2											
	3											
B	4											
	5											
	6											
C	7											
	8											
	9											
D	10											
	11											
	12											
E	13											
	14											
	15											

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

REPEAT

Figure 4-28

Signal operating plan No. 7—intersection of two divided streets with service roads—stop or signal control on the service roads—without pedestrian signals.



Sequence of Signal Indications using a Pretimed Controller

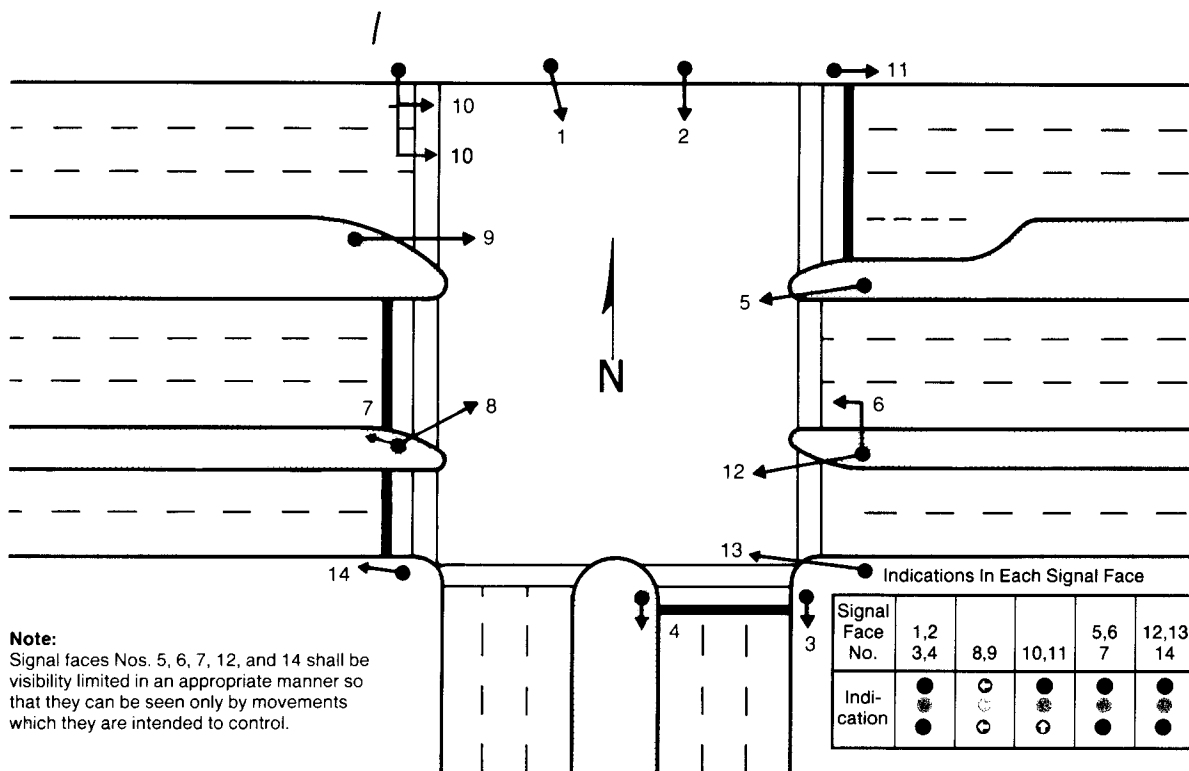
Direction		Northbound			Southbound			Eastbound			Westbound			Movements
Signal Face No.		Veh.	Veh.	Ped.	Veh.	Veh.	Ped.	Veh.	Veh.	Ped.	Veh.	Veh.	Ped.	
Phase	No.	*1,2	3,4,5	P1-P4	6,7	8,9	P5-P8	11,12	13	P9-P12	14,15	16	P13-P16	
A	1	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
	2		●	●		●	●	●	●	●	●	●	●	◀
	3	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
	4	◀	●	●	◀	●	●	◐	●	◐	●	●	◐	◀
	5	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
	6	◀		●	◀		●	●	●	●	●	●	●	◀
	7	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
B	8	◀	●	●	◀	●	●	◀	●	●	◀	●	●	◀
	9	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
	10	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
	11	◀	●	◐	◀	●	◐	●	●	●	●	●	●	◀
	12	◀	●	●	◀	●	●	●	●	●	●	●	●	◀
	13	◀	●	●	◀	●	●			●			●	◀
	14	◀	●	●	◀	●	●	●	●	●	●	●	●	◀

Note: The arrow indication in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

REPEAT

Figure 4-29

Signal operating plan No. 8—leading protected/prohibited left turn from two approaches—leading protected/permisive left turn from two other approaches—intersection of two divided streets with left-turn bays—with pedestrian signals.



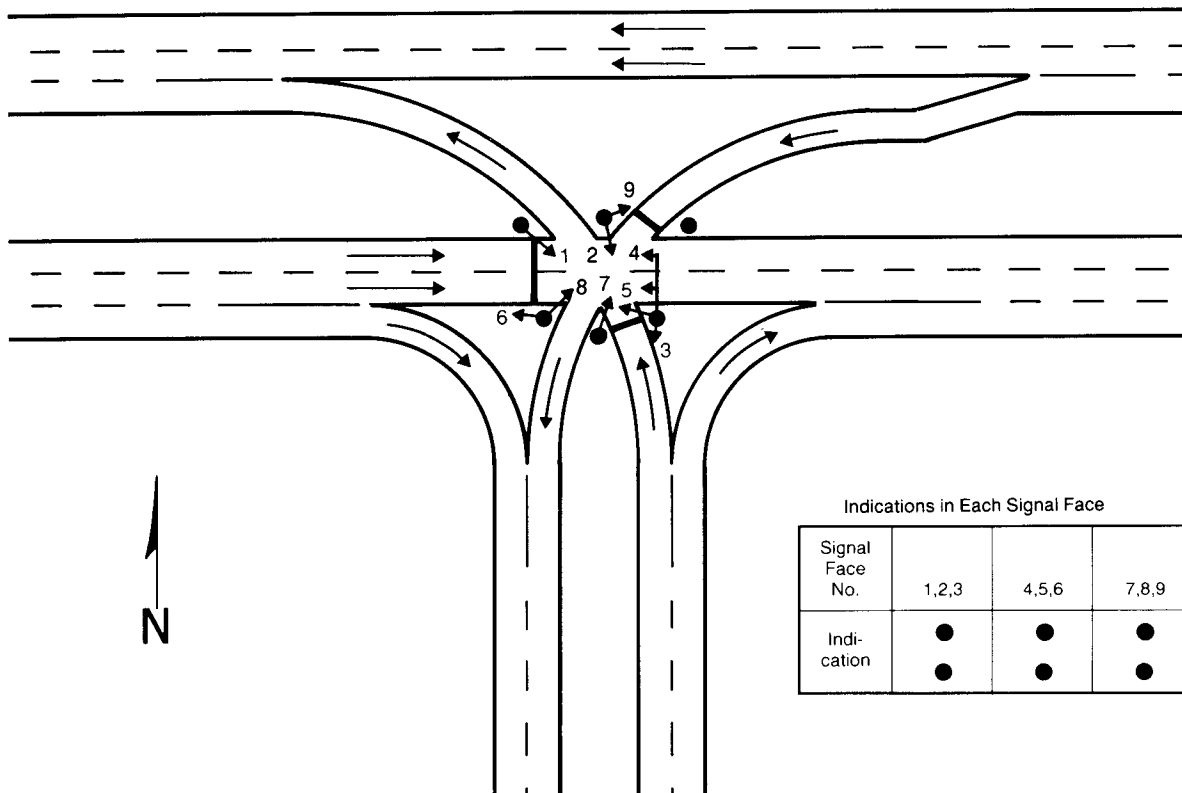
**Sequence of Signal Indications using a Pretimed Controller**

Direction		North Bound	Main Road			Service Road	Movements
Signal Face			West Bound		East Bound	East Bound	
Phase	Int. No.	1,2,3,4	8,9	10,11	5,6,7	12,13,14	
A	1	●	⬅	●	●	●	
	2	●	⬅	●	●	●	
	3	●	⬅	●	●	●	
B	4	●	⬅	⬆	●	●	
	5	●	●	⬆	●	●	
C	6	●	⬅	⬆	●	●	
	7	●	⬅	⬆	●	●	
	8	●	⬅	⬆	●	●	
D	9	●	⬅	⬆	●	●	
	10	●	⬅	●	●	●	
	11	●	⬅	●	●	●	

**Note:** The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**REPEAT**

**Figure 4-30**  
**Signal operating plan No. 9—"T" intersection with a one-way service road along the principal street—no pedestrian signals.**

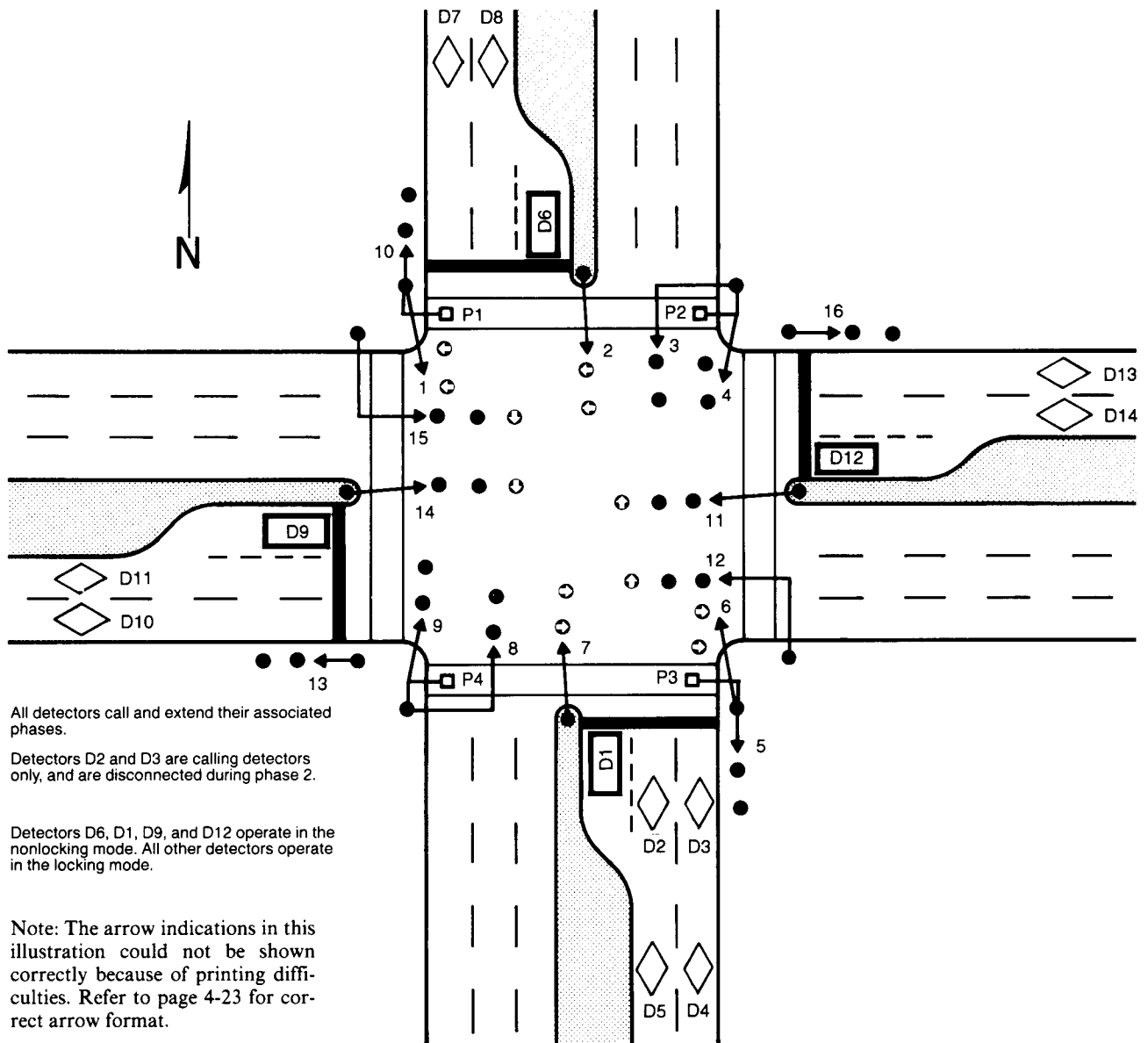


**Sequence of Signal Indications Using a Pretimed Controller**

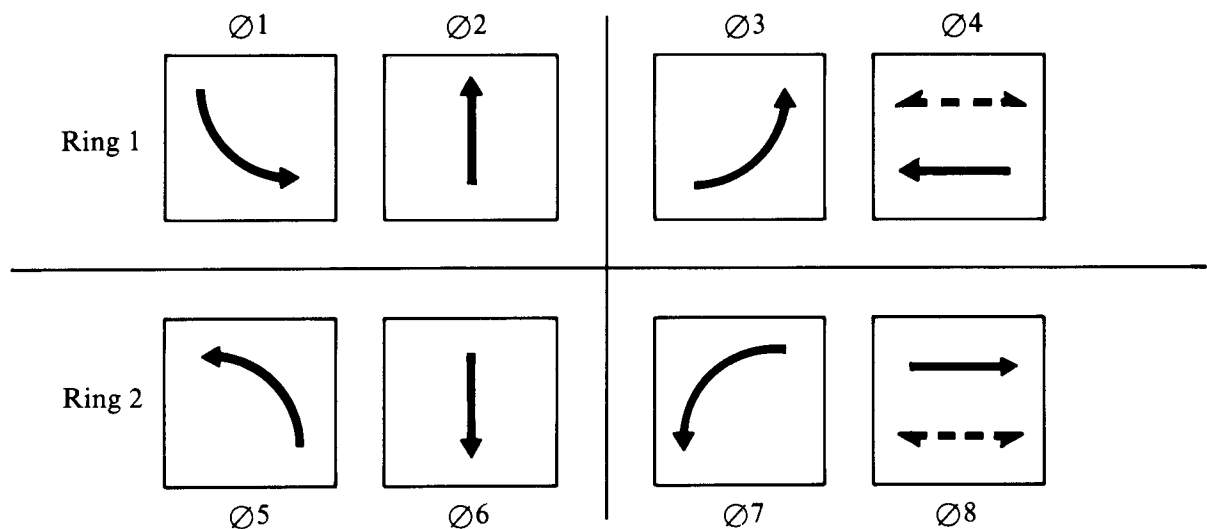
Direction		North Bound 1,2,3	South Bound 7,8,9	East Bound 4,5,6	Movements
Phase	Interval				
A	1	●	●	●	
	2		●	●	
	3	●	●	●	
B	4	●	●	●	
	5	●		●	
	6	●	●	●	
C	7	●	●	●	
	8	●	●		
	9	●	●	●	

REPEAT

**Figure 4-31**  
Signal operating plan No. 10—"T" intersection with left-turn bay—continuous traffic on the principal street.























































































































**Figure 4-32 Part A**  
**Intersection plan—traffic-actuated signal with pedestrian signals.**



**Figure 4-32 Part B**  
**Movements during each of the phases.**

Phase Having Green	Non-conflicting Phase Allowed to Time Concurrently	Phases in Conflict With Phase Having Green
1	5 or 6	2-3-4-7-8
2	5 or 6	1-3-4-7-8
3	7 or 8	1-2-4-5-6
4	7 or 8	1-2-3-5-6
5	1 or 2	3-4-6-7-8
6	1 or 2	3-4-5-7-8
7	3 or 4	1-2-5-6-8
8	3 or 4	1-2-5-6-7

**Figure 4-33 Part A**  
Table of conflicting and nonconflicting phases.

Phase	Signal Face	R/W	Ø1 (6,7)					R/W	Ø2 (3,4,5)					R/W	Ø3 (11,12)					R/W	Ø4 (14,15,16)								
			CLEAR TO						CLEAR TO						CLEAR TO						CLEAR TO								
			**						**						**						**								
Ø1	6,7																												
Ø2	3,4,5																												
Ø3	12,13																												
Ø4	14 15,16,																												
Ø5	1,2																												
Ø6	8,9,10																												
Ø7	14,15																												
Ø8	11 12,13,																												
Ø1P	Walk N.X.																												
Ø2P	Walk S.X.																												

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format. See Figure 4-16 for symbols.

**Figure 4-33 Part B**  
Signal indications to be used in the change and clearance intervals.

Phase	Signal Face	Ø5 (1,2)						Ø6 (8,9,10)						Ø7 (14,15)						Ø8 (11,12,13)					
		R/W	CLEAR TO				R/W	CLEAR TO				R/W	CLEAR TO				R/W	CLEAR TO							
			**					**					**					**							
Ø1	6,7	●	●	●				●	●	●				●	●	●				●	●	●			
Ø2	3,4,5	●	●	●				●	●	●				●	●	●				●	●	●			
Ø3	11,12	●	●	●				●	●	●				●	●	●				●	●	●			
Ø4	14 15,16,	●	●	●				●	●	●				●	●	●				●	●	●			
Ø5	1,2	⬅	●					●	●	●				●	●	●				●	●	●			
Ø6	8,9,10	●	●	●				●		●				●	●	●				●	●	●			
Ø7	14,15	●	●	●				●	●	●				⬅		●				●	●	●			
Ø8	11 12,13,	●	●	●				●	●	●				●	●	●				●		●			
Ø1P	N.X. Walk	●	●	●				●	●	●				●	●	●				●	●	●			
Ø2P	S.X. Walk	●	●	●				●	●	●				●	●	●				⬅	●	●			

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

**Figure 4-33 Part C**  
**Explanatory notes.**

**\*\*** Indicates clearance to any phase in conflict with the phase having the green indication.

**\*** The red indication for these phases is the same as for the corresponding through movement.

**W** Means that when called for by a prior pedestrian detector actuation at one end of that crosswalk, a WALK indication is displayed, followed by flashing DON'T WALK (change) and then steady DON'T WALK (clearance) indications. Phase 3 or 7 signal indication which would permit movement of vehicles across a crosswalk having a WALK indication are prohibited.

Phases 1 and 5 are the protected part of prohibited/protected left turns.

Phases 3 and 7 are the protected part of prohibited/permmissive left turns.

When phases 2 and 6 or 4 and 8 are timing concurrently, they shall terminate simultaneously to prevent the occurrence of lagging left turn conflicts. Phases on opposite sides of the barrier cannot occur simultaneously.

At any one time, only one of the phases in Ring 1 may occur at the same time as only one of the phases in Ring 2.

mains. Each time-base unit can be set to regulate the cycle, splits, and offset of its associated controller. Because of the timing stability of the time-base coordinator, the time relationships of the signals in the system do not change over long periods of time. Time-based coordinators are available which can be programmed for a time period of a week or a full year.

4. Until recently, coordination was usually accomplished by a master controller which supervised the operation of local controllers at individual intersections. The availability of computerized equipment has made possible more complex and efficient coordinated control of signal networks. Much useful information on this subject is available in periodicals, handbooks and manufacturers literature, and should be consulted if a coordinated network is anticipated.

#### **F. Flashing Operation of Traffic Control Signals**

1. All traffic control signal installations shall have electrical mechanisms which will flash the signal indications when activated by a manual or automatic switch. It shall be possible to remove the signal timer without affecting the flashing of the indications. During flashing operation, the indications shall be flashed at a rate of not less than one-half nor more than two-thirds of the total flash cycle. The signal indications which are flashed shall be as specified in Section 4.03 B5a.

2. Automatic changes (by time clock or remote control) from flashing to stop-and-go operation shall be made when a green indication is shown in both directions on the major street. Where there is no such green indication for both directions, the change shall be made at the beginning of the green interval for the greatest traffic movement on the major street.

3. Automatic changes from stop-and-go to flashing operation shall be made at the end of the period during which the red indication is shown in both directions on the major street.

4. The operation of the manual "flash" switch or the "fail-safe" conflict monitor (See Section 4.05 C), shall cause the immediate change from stop-and-go to flashing operation. Restoring the manual "flash" switch to the "automatic" position or operation of the conflict monitor reset switch shall cause the immediate change from flashing to stop-and-go operation.

5. A short, steady all-red interval shall be given to all minor street approaches before

changing from flashing red to green on a minor approach.

6. There is usually a period of 4 or more consecutive hours of the night when the volume of traffic is much less than in the daytime. During such periods, when traffic is less than 50 percent of the volume criteria in Section 4.02 of this chapter, a pretimed signal shall be placed on flashing operation. Traffic-actuated signals should normally not be placed on flashing operation during such times of lower traffic. At such times, a properly adjusted and maintained traffic-actuated signal will not cause unnecessary delay to traffic and will provide safer traffic movement than would flashing operation.

7. When a traffic control signal is placed on flashing operation, the following signal indications shall normally be displayed:

a. Flashing yellow in all indications facing traffic on the main street or highway.

b. Flashing red in all indications facing traffic on the minor or cross streets. At some intersections, traffic volumes on the main and cross streets may be nearly equal and accidents may be a problem. In such cases, flashing red may be displayed in the indications facing main street traffic and also those facing cross street traffic.

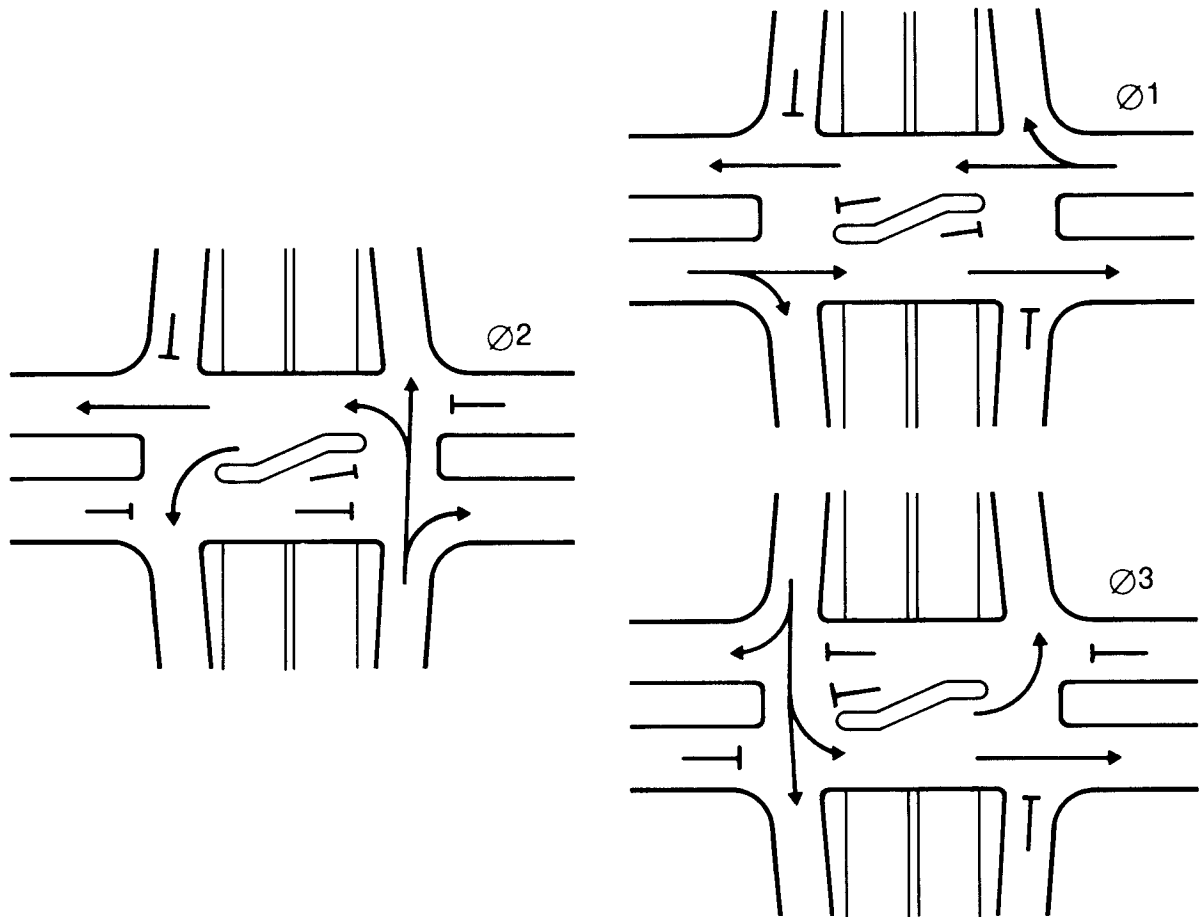
8. A traffic control signal indication that is sufficiently bright to be effective in the daytime may be too bright at night. Therefore, except in urban areas with bright surroundings and on high speed rural roads, indications should be automatically dimmed at night. The dimming device should reduce the light output of each signal indication proportionally as the ambient light level decreases. The reduction shall be not more than 50 percent and not less than 30 percent of the light output at full rated voltage.

#### **G. Continuity of Operation of Traffic Control Signals**

1. A traffic control signal installation, except as provided below, shall at all times be operated either as a stop-and-go device or as a flashing device:

a. Before being placed in operation, during major reconstruction, or a seasonal shutdown, a signal may not be operating. In such cases, the signal faces should be covered, turned away from the street, or removed to clearly indicate the signal is not in operation.

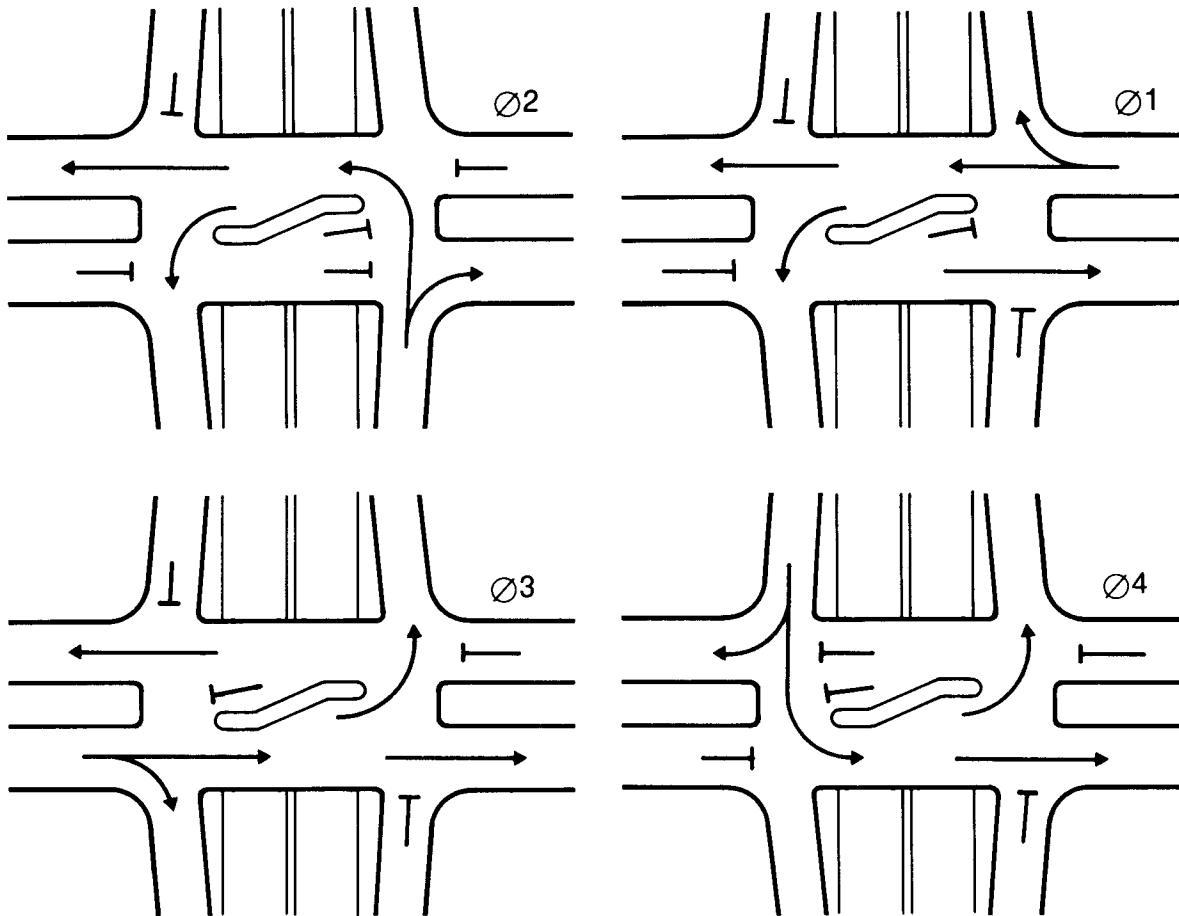
b. When a traffic control signal installation is being operated as a stop-and-go device, at least one indication in each signal face shall be illuminated.



**Notes:**

May be either pretimed, if it can be included in a coordinated system, or may be traffic actuated.  
 Is not recommended where vehicles turning left off of ramps or frontage roads are numerous.  
 Is generally not suitable for an urban location.

**Figure 4-34**  
**Three-phase lead-lag diamond interchange ramp signal sequence.**



**Notes:**

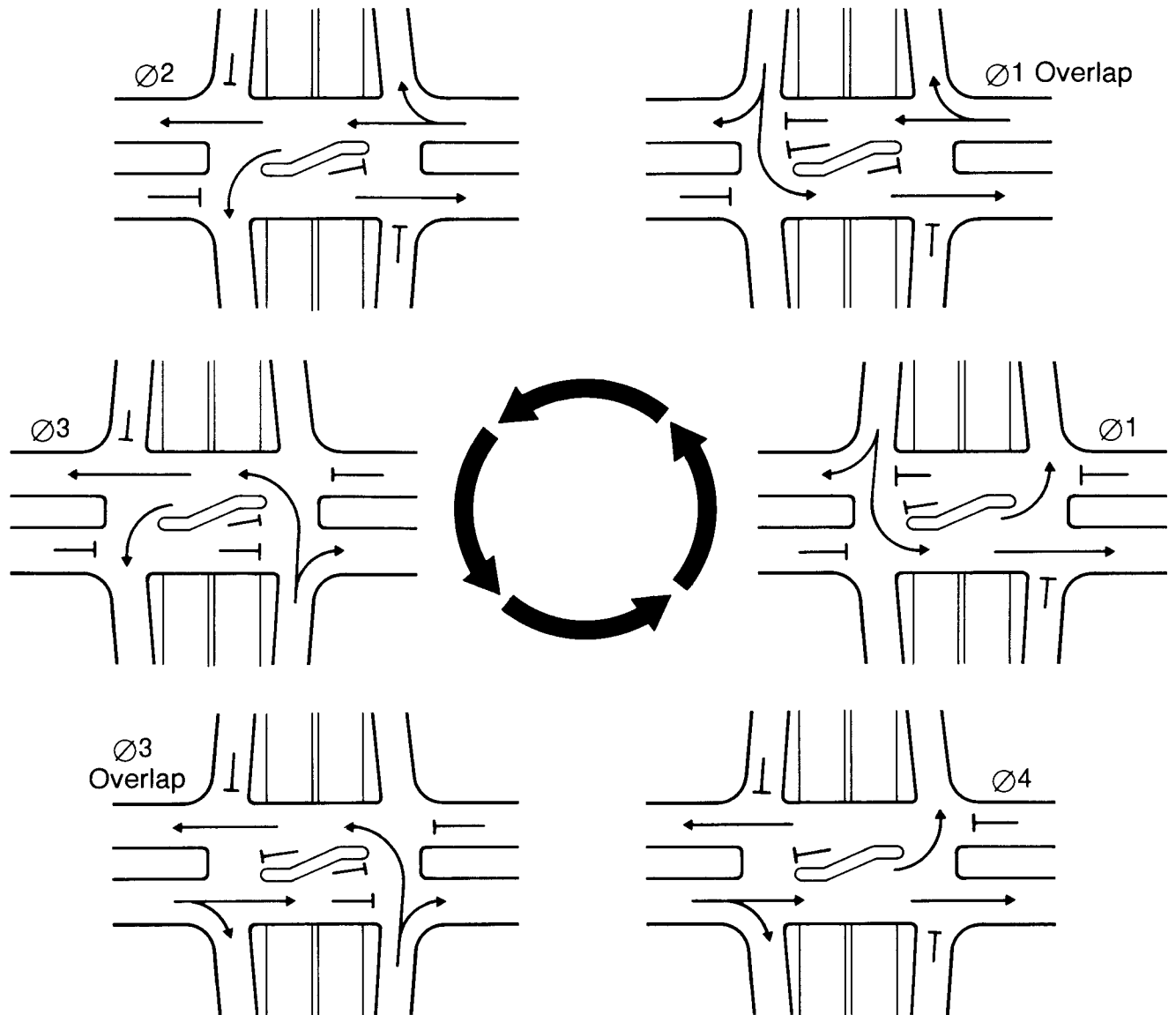
Very good when there is much ramp traffic, and more on one ramp than the other.

Minimizes the need for provision for vehicles stopped on the cross street awaiting an opportunity to turn left.

Must be pre-timed.

Is not as efficient as the four-phase, two-overlap sequence.

**Figure 4-35**  
**Four-phase diamond interchange ramp signal sequence.**



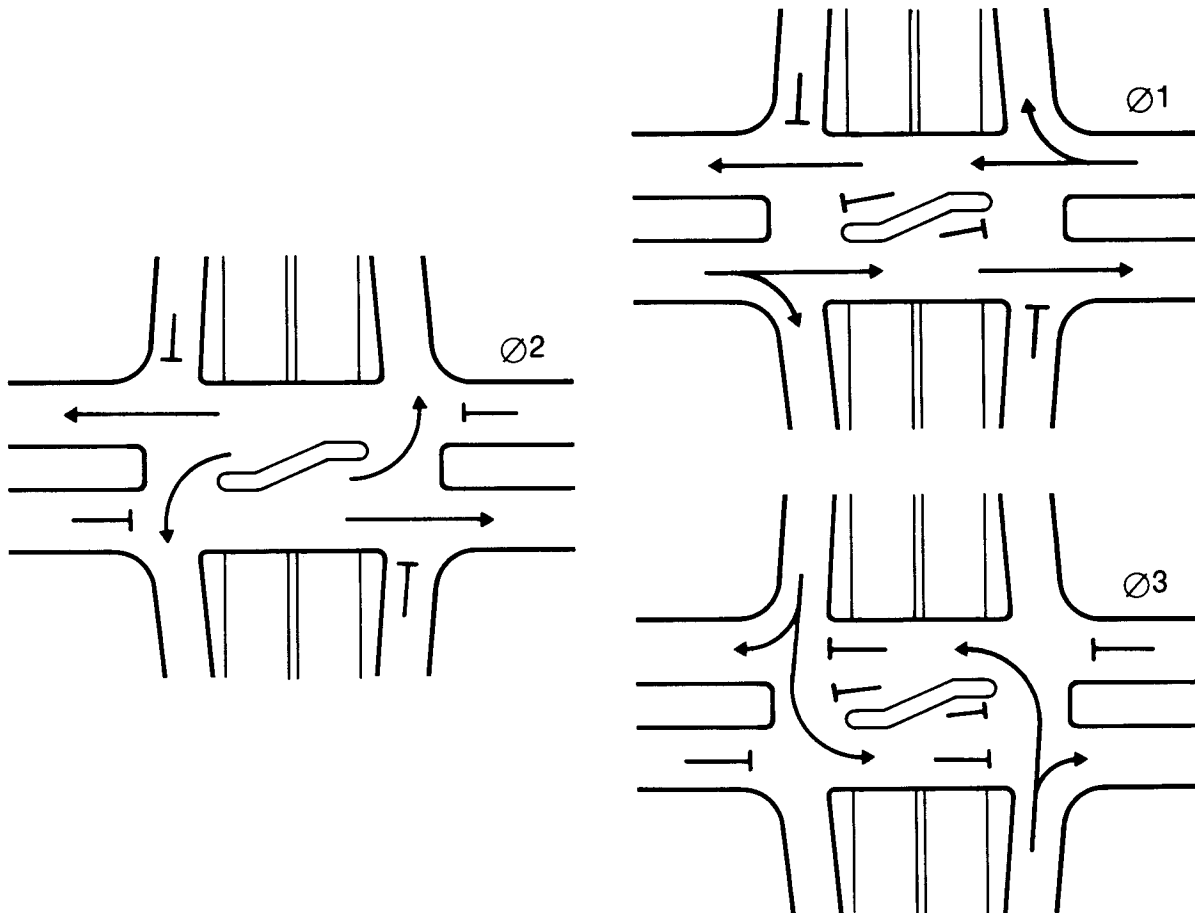
**Notes:**

Must be pretimed.

Makes efficient use of green time. More efficient than any other system.

Is especially effective at interchanges where the spacing between ramp terminals is short and left turn storage is limited.

**Figure 4-36**  
**Four-phase two-overlap diamond interchange ramp signal system.**



**Notes:**

Has high traffic capacity when there is a large number of cross street vehicles and relatively few left turns.

Can use a shorter cycle than for other phasing.

Especially good when ramps are 120 m to 150 m apart along the cross road.

The phasing can readily be produced by a standard three-phase traffic-actuated controller.

**Figure 4-37**  
**Three-phase lag-lag diamond interchange ramp signal system.**

c. When a traffic control signal installation is being operated as a flashing device, at least one indication in each signal face shall be flashed.

d. The indications of traffic control signals for emergency vehicle entrances do not have to be steadily illuminated or flashed except when those signals are activated.

2. A GREEN ARROW indication used alone to permit a continuous movement shall be constantly illuminated when other indications in the signal installation are flashed.

#### **H. Control Preemption by Priority Traffic**

1. Special classes of traffic (emergency vehicles, trains, transit vehicles, and certain official vehicles) may require priority over other traffic. Equipment is available to allow such traffic to modify the timing, sequence, or display of traffic signal indications. Change and clearance intervals and displays shall be provided when a priority vehicle causes a change in the normal timing, sequence or signal display. Priority control may be established over one signal, or over all or parts of an entire signal system.

2. The indications of signals under priority control should allow traffic to continue to move as normally as possible without delay or hazard to priority vehicles. Long all-red or flashing signal sequences shall not be used.

#### **I. Maintenance of Traffic Control Signals**

1. Proper and reliable operation of traffic control signals involves regular and emergency maintenance. This includes maintenance to reduce the likelihood of the failure of any signal component and prompt repair or replacement of malfunctioning signal units.

2. Traffic signal equipment occasionally fails to function properly. If a breakdown or failure of the equipment occurs, control should be reestablished in one of the following ways:

- a. Automatic or manual transfer to a predetermined flashing mode.
- b. Manual traffic direction by proper authority.
- c. Temporary erection of other traffic control devices.

3. Traffic control signals have complex electrical and electronic equipment. Special training and skills are needed to provide the maintenance necessary to keep the signals

operating properly and to restore the signals to operation after an equipment failure occurs. Types of work include the following:

- a. Routine preventative maintenance and identification of problems with controllers and associated equipment.
- b. Cleaning and replacement of signal lamps on a schedule that will minimize interruption of signal operation due to lamp failure.
- c. Maintenance of an adequate stock of replacement control equipment and spare parts.

4. The appearance and effectiveness of an installation should be maintained by scheduled cleaning and adjustment of signal lenses and reflectors, and by painting signals and supports. Yellow posts shall be used for post-mounted signal heads. The signal head housings, insides of visors, entire surface of louvers, and surface of backplates shall have a dull black or dark green finish. Backplates may have a white border.

5. To provide efficient and safe operation of an intersection, the traffic signal control equipment must be operated in accordance with its predetermined timing schedule. Timing changes should be made only by authorized persons. A written record should be made of all timing changes, inspections, and other work done on any signal, and a copy should be placed in the cabinet. A copy of the timing plan and wiring scheme should also be kept in the cabinet. Also, a copy of all records shall be maintained by the local authority.

#### **J. Vehicle Detectors**

1. Traffic-actuated signal control is generally more efficient than pretimed control at intersections which are not part of a signal system. However, the efficiency of traffic-actuated signal control is greatly affected by the type, placement, and maintenance of the vehicle detectors used with the signal.

2. It is best to use detectors capable of registering the presence of a vehicle at the detector as well as the passage of the vehicle over the detector.

3. Detectors (or the associated controller) may have one or more of the following characteristics, all of which add to the usefulness of the detector:

- a. Presence mode, which means the detector gives an indication as long as a vehicle is over the detector.
- b. Pulse mode, in which the detector gives only a short (pulse) indication when

a vehicle or axle passes over it.

c. Holding or nonholding mode. In the holding mode, the detector actuation is held after the vehicle leaves the detector until the actuation is released by the detector or controller. In the nonholding mode, the detector actuation is discontinued by the detector or the controller when the vehicle leaves the detector.

d. Delay timing, which means the detector does not transmit the vehicle actuation to the controller for a predetermined adjustable time.

e. Extension timing, which means the detector prolongs the transmission of an actuation to the controller after the passage of a vehicle.

4. At some locations, total entering traffic on the major street is more than twice the traffic on the minor street. In such cases, the detectors on the minor street should be placed closer to the stop line than those on the major street.

5. On low volume minor streets, vehicles entering the street from driveways between a detector and the stop line do not register their presence and may not receive the green light for a considerable time. In such cases an additional detector should be placed between the stop line and the nearest driveway. Any vehicle crossing this detector will register their presence and call for the right-of-way and will not be unnecessarily delayed. This will require a reduction in the length of the vehicle extension timing on that approach. As an alternative, the controller can be designed to respond only to the first impulse in each cycle from the detector farthest from the intersection.

6. At traffic-actuated signals, detectors are required in separate turning lanes to secure the right-of-way for vehicles in those lanes. Turning vehicles can frequently complete the turn and leave the intersection on the GREEN DISK signal indication. Thus, the right-of-way does not have to be transferred to the turning lanes causing unnecessary delay to other traffic. Therefore, detectors and associated equipment for such lanes should be designed to register the need for right-of-way only when a vehicle is present in the lane.

7. Detectors shall be placed where vehicles

traveling away from the intersection will not affect the controller. On narrow two-way roadways this may require a special type of directional detector which will be actuated only by vehicles going toward the intersection.

#### **K. Use of Signs with Traffic Control Signals**

STOP signs shall not be used with traffic control signals except:

1. When the signal indication flashes red at all times.

2. When a minor street or driveway with little traffic enters the intersection or controlled area.

3. When the signal must be operated for a considerable time in the flashing mode. In that case, STOP signs may be desirable to supplement the flashing red signal indications.

4. When the signal installation is temporarily without electrical power, and STOP signs must be erected on some or all of the approaches.

#### **L. Operation of Traffic Control Signals by Hand Control**

1. A mechanism shall be provided to permit authorized personnel to operate the signal manually to control traffic. This shall include the required switch to transfer from automatic to hand operation, and a push-button switch on a 1-m electrical cord for the purpose of changing the signal indications.

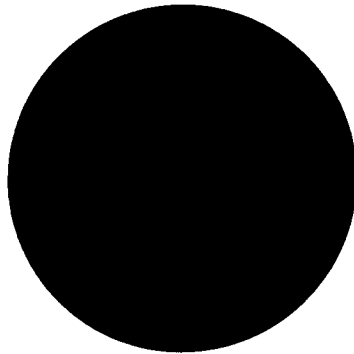
2. When a traffic signal is being operated by hand control, the lengths of the yellow change intervals and red clearance intervals, if used, shall be controlled by the signal timing mechanism.

3. Properly timed and maintained traffic control signals are efficient in moving traffic through an intersection. Hand control of a signal in a progressive signal system will interrupt the smooth flow of traffic through the system. The temporary improvement in traffic flow at that intersection will be offset by a decrease in efficiency for the system as a whole. It is recommended that signals be manually controlled only for special, temporary events.

## 4.06 Pedestrian Signal Indications

### A. Meaning of Pedestrian Signal Indications

1. Pedestrian signal indications are used to give pedestrians better information for safe crossing than can be given by the vehicular indications alone. These indications consist of the white figure of a walking man, symbolizing permission to walk (Walk) and a representation of an orange-colored standing man, symbolizing prohibition of walking (Don't Walk). (See Figure 4-38).



Orange  
Don't Walk  
Indication



White  
Walk  
Indication

**Note:**  
The above drawings are schematic only.  
Lenses may be circular or rectangular.

**Figure 4-38**  
**Pedestrian signal indications.**

2. The meanings of pedestrian signal indications are:

- The standing man symbol (when steadily illuminated) means pedestrians facing the signal shall not enter the roadway.
- The standing man symbol (when flashing) means pedestrians shall not start to cross the roadway. However, any pedes-

trian who has partly completed crossing the roadway shall proceed to a sidewalk or to a safety island.

- The walking man pedestrian indication means pedestrians may cross the roadway within the crosswalk limits in the direction of the indication.

### B. Use of Pedestrian Signal Indications

1. Pedestrian signal indications shall be installed in conjunction with vehicular traffic control signals under any of the following conditions:

- When a traffic control signal is installed because either the Pedestrian Volume or the School Crossing Criterion is met.
- When it is necessary to give vehicles a signal indication to stop them from crossing the path of a pedestrian movement. A signal indication is then necessary to tell pedestrians when they may walk.
- When vehicular signal indications are not sufficiently visible to pedestrians, particularly on one-way streets or at a "T" intersection.
- At officially designated school crossings at intersections signalized under any criterion.
- At wide intersections where pedestrians must make the crossing in stages.

2. Pedestrian signal indications are desirable wherever it is necessary to assist pedestrians, particularly at complex or large intersections. These signals show the periods of the signal cycle when pedestrian crossing has the least vehicular interference. Normally, pedestrian indications need not be placed at intersections where few pedestrians cross the major street.

### C. Design of Pedestrian Signal Indications

1. Pedestrian indications shall be adequately bright and legible to be effective under all normal atmospheric conditions. These indications shall attract attention and be readable by pedestrians (day and night) at all distances from 3 m to the full width of the area to be crossed.

2. Lenses for pedestrian indications may be either rectangular or round in shape, displaying either the orange standing man symbol or the white walking man symbol. The signal indications shall be internally illuminated.

3. When illuminated, the walking man symbol shall be white on a black background.
4. When illuminated, the standing man symbol shall be orange on a black background.
5. When not illuminated, pedestrian indications shall not be readily distinguishable by pedestrians from the far end of the crosswalk.
6. Symbols at least 150 mm high shall be used if the distance from the near curb to the pedestrian signal indication is 35 m or less. Where that distance is more than 35 m, the symbols shall be at least 225 mm in height.
7. When pedestrians are required to cross the street on two or more stages, optically-programmed Walk - Don't Walk pedestrian signal indications shall be utilized. These indications shall be installed so that the pedestrian will view only the indication which applies to him.

#### **D. Location of Pedestrian Signal Indications**

1. Pedestrian signals shall be mounted with the bottom of the housing not less than 2 m nor more than 3 m above the sidewalk level.
2. For each direction on each crosswalk, pedestrian indications shall be in the normal line of vision of pedestrians. The preferred location of the pedestrian signal face is at the end of each crosswalk. The indications shall be positioned and adjusted for maximum visibility at the far end of the crosswalk. The pedestrian indication shall be located within 3 m of the extension of the crosswalk lines.
3. Pedestrian signal heads may be mounted separately or on the same support as the vehicular signal heads. Vehicular and pedestrian signal heads on the same support shall be separated by a space of not less than 150 mm when both signal heads face in the same direction.
4. Pedestrian signal heads and indications shall meet the specifications of the Kingdom of Saudi Arabia with respect to color, lens transmittance, light distribution, and physical characteristics.

#### **E. Pedestrian Pushbutton Detectors**

1. Pedestrian detectors shall be installed at any traffic-actuated signal for any crosswalk having pedestrian indications except as described in paragraph F.2. Detectors and indications shall be omitted for a crosswalk if it is closed.
2. Pedestrian detectors (usually buttons which must be pushed by pedestrians) shall

be located within easy reach of pedestrians at each end of each crosswalk where pedestrian actuation is required. The position of the pushbutton with respect to the crosswalk should clearly show it is intended for pedestrians using that crosswalk.

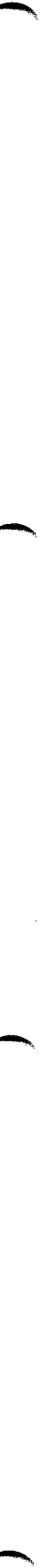
3. Detectors shall be mounted on a strong support at a height of from 1 to 1.2 m above the sidewalk. Small signs shall be mounted above or as a part of each detector to explain their purpose and use. Additional pushbutton detectors may be needed on median islands where a pedestrian might seek refuge from traffic.

#### **F. Pedestrian Signal Phases and Interval Timing**

1. Pedestrians shall be assured of sufficient time to cross the roadway during the pedestrian change/clearance period at a signalized intersection where pedestrian indications are used. Some pedestrians, particularly the very young, old, or handicapped, walk more slowly than other pedestrians. The length of the pedestrian change/clearance interval must be adjusted to accommodate those differences in walking speed where young, old, or handicapped pedestrians frequently cross.
2. Pedestrian pushbutton control of traffic-actuated signals gives pedestrians sufficient crossing time by extending the green time given to vehicles. Even where traffic signals are pretimed it is sometimes desirable to provide pedestrian pushbuttons. Often pedestrian detectors are installed for crosswalks across the major street, but not across the minor street. In those cases, pedestrian actuation extends the minor street vehicular green time which will usually reduce the major street green time. Where pedestrian actuation is not practical, and pedestrians are often present, the vehicular green time shall provide at least the minimum crossing time needed by pedestrians.
3. The minimum Walk interval, when the white walking man indication is shown, shall be not less than 3 seconds and a maximum of 7 seconds. Additional time, if needed, shall be added to the clearance period. The Walk indication may be shown for the vehicular green period minus the time required for the pedestrian change/clearance indication. However, the length of the Walk period need not equal the time required for pedestrians to walk completely across the street, as they can complete their crossing during the change/clearance period. At traffic-actuated signals, the standing man indication shall be shown unless there has been a pedestrian actuation.

4. A pedestrian change/clearance interval shall always be provided where pedestrian signal indications are used. This interval shall be long enough to allow a pedestrian to walk across the entire roadway or to a median island before vehicles crossing his path receive a green indication. The normal walking speed is assumed to be 1.25 m/s.

5. Pedestrian indications shall always be displayed when the traffic signal is operating as a stop-and-go device. Pedestrian indications shall not be illuminated when the traffic control signal is operating as a flashing device. When pedestrian pushbuttons are provided, the buttons shall be operating at any time the pedestrian indications are operating.



## 4.07 Flashing Beacons

### A. Hazard Identification Beacon

1. A Hazard Identification Beacon is a traffic signal giving a flashing **YELLOW DISK** indication. A Hazard Identification Beacon may have one or two yellow indications. If there are two, the indications shall be flashed alternately. The beacon shall be used only to supplement an appropriate Warning or Regulatory sign.

2. Typical uses for Hazard Identification Beacons include the following:

- (a) Warn of obstructions in or immediately adjacent to the roadway.
- (b) Call attention to and increase the effectiveness of Warning signs.
- (c) Provide warning for crosswalks, especially those not at an intersection.
- (d) Warn of intersections, particularly where accidents have been recorded.
- (e) Supplement and call attention to Regulatory signs, except for STOP, Give Way, and Entry Prohibited signs. If a beacon is needed for those three signs, it shall be red.

3. Hazard Identification Beacons shall be operated only during those hours when the hazard or regulation exists.

4. The hazard or other condition warranting a Hazard Identification Beacon will usually determine its location and the sign used with it.

5. A Hazard Identification Beacon shall be supplemented by a suitable sign when used on an obstruction in the roadway. In addition, the area of the obstruction should be illuminated.

6. A 300 mm lens shall be used only with a sign larger than the standard size.

### B. Speed Limit Sign Beacon

1. Speed Limit Sign Beacons are intended for use where signs alone have not been effective in controlling speed. The beacons are required with mechanically or electrically changeable Speed Limit signs. Too frequent use of the beacons, however, may reduce their effectiveness.

2. A Speed Limit Sign Beacon is a signal having one or two **YELLOW DISK** lens sections. If one lens is used, it shall have a visible diameter of not less than 200 mm. If two lenses are used, the lenses shall have a visible diameter of not less than 150 mm. The two lenses shall be illuminated alternately. If the sign is higher than it is wide,

one lens shall be at the top of the sign and the other at the bottom. If the sign is longer horizontally than it is high, the lenses may be at the left and right of the sign. A 300 mm lens may be used only with a Speed Limit sign larger than the standard size.

3. A Speed Limit Sign Beacon may be used with a standard Speed Limit sign which shows an unchanging message. It may also be used with a Speed Limit sign on which the indicated speed limit may be changed mechanically, electrically, or by hand.

4. A changeable message Speed Limit Sign Beacon may be controlled by a 7-day programmable time clock or other reliable means so the beacon operates only during those hours and days when the regulation is in effect.

### C. Intersection Control Beacon

1. Intersection Control Beacons have flashing **YELLOW DISK** or **RED DISK** indications in each face. These beacons are used at intersections to warn and control one or more directions of travel. More than one indication may be needed on some approaches to provide adequate visibility.

2. Intersection Control Beacons are used at intersections where traffic control signals are not warranted, but accident experience indicates a special hazard. Only the following combinations of signal indications shall be used:

(a) Yellow indications on one route (normally the major route) and red on all other approaches, or

(b) Red on all approaches to the intersection. This is permissible only where an all-way stop is warranted.

3. A STOP sign in the normal, approved location shall be used with a flashing red Intersection Control Beacon. Intersection advance Warning signs are normally used on approaches having a flashing yellow beacon. Flashing yellow beacons shall never face two or more vehicle movements which cross or otherwise conflict.

4. Two-hundred mm lenses are customarily used in Intersection Control Beacons. Three-hundred mm lenses may be used where high traffic volume or speed necessitate greater visibility and effectiveness.

5. If two or more indications are shown to any one approach, these indications shall be flashed simultaneously.

#### **D. Stop Sign Beacon**

1. A Stop Sign Beacon is a signal with one or two flashing RED DISK indications used with a STOP sign.
2. The lens of a Stop Sign Beacon shall have a visible diameter of not less than 200 mm. Where greater effectiveness is needed, two separate beacon and sign installations may be made. One shall be on the right side of the approach and one overhead or on the left of the approach. This will usually be more effective than a beacon with a 300 mm lens. If two lenses are used with a STOP sign, the lenses shall be placed above and below the sign, and shall be alternately illuminated. The standard beacon shall have one lens. Two-lens beacons shall only be used where accident experience shows single-lens beacons have not been effective.

#### **E. Design and Operation of Flashing Beacons**

1. Flashing beacons usually consist of one or more sections of a traffic control signal head. Except as modified by this section, the physical and optical characteristics of beacons shall comply with the requirements for traffic control signal heads.
2. The lens in each beacon, except the Speed Limit Sign Beacon, shall have a visible diameter of not less than 200 mm.
3. When illuminated, the indication of the beacon shall be clearly visible as a full disk in the direction it is aimed. Unless it is physically obstructed, the indication shall be visible for a distance of at least 400 m under all normal lighting and atmospheric conditions.
4. All beacons shall be flashed at a rate of not less than 50 nor more than 80 times per minute. The illuminated period of each flash shall not be less than one-half nor more than two-thirds of the total cycle. The mechanism that causes the beacons to flash shall be equipped with filtering devices for suppression of radio frequency electrical interference.
5. When a 1,750 lumen lamp is used in a 300 mm yellow flashing beacon, the indication may be excessively bright at night. Therefore, except in urban areas with bright surroundings and on high speed rural roads, a device shall be used to automatically reduce the light output of the beacon at night proportionally as the ambient light level decreases. The reduction shall be to not more than 50 percent and not less than 30 percent of the light output at full rated voltage.
6. Flashing Beacons, except for Intersection Control Beacons, are generally used with signs. If so, these beacons must be separated by 300 to 400 mm from the nearest edge of the sign (This limitation does not apply to School Speed Limit Beacons.) If the beacon is too close to the sign, its brilliance will seriously interfere with the legibility of the sign at night.
7. Flashing Beacons shall never be mounted on pedestals in the roadway. A Flashing Beacon may be placed on a pedestal on a traffic or pedestrian island, but the support shall be of breakaway design.
8. The installation requirements for the sign will usually establish the location, height, and lateral clearance of the combined sign and beacon. The beacon alone or with an accompanying sign may be over the roadway. In such cases, the clearance above the pavement shall not be less than 5.8 m nor more than 6.5 m. The sign and Flashing Beacon should be in the same vertical plane.

## **Part 5. Traffic Controls for Work Areas**

### **5.01 Introduction and General Specifications**

#### **A. Need for Standards**

1. Part 5 of the Manual establishes principles to be observed in the design, installation, and maintenance of traffic control devices in work areas. These principles and standards are used for the safe and expeditious movement of traffic through work areas, and to insure the safety of the work force performing these operations.

2. Problems occur when traffic must be moved through or around road or street construction, maintenance operations, and utility work areas. Examples of various conditions encountered in work areas are included in this Manual. The examples are identified as "cases."

#### **B. Scope**

Devices required for the control of traffic through work areas include signs, signals, lighting devices, markings, barricades, barriers, channelizing, and hand signaling devices.

#### **C. Responsibility**

The standards of public protection established in this Manual are used by (1) Ministry of Communications, (2) contractors or employees of municipalities engaged in work area operations under contract to the Ministry, and (3) all others, including employees of public utility companies, performing any work on highways or so closely adjacent as to create hazards for the public or for themselves.

#### **D. Application of Standards**

1. The general principles outlined in this Manual are applicable to rural and urban areas. Since it is not practicable to prescribe detailed standards for all the situations which could conceivably arise, minimum standards are shown for the most common situations (See Case Illustrations I-XIII). Additional protection must be provided when special complexities and hazards prevail. The protection prescribed for each situation shall be based on the speed and volume of traffic, duration of the operation, and exposure to hazards. Each construction project shall include a Traffic Control Plan, which shows the detailed use of specific traffic control devices used on that project.

2. High volume roads present problems requiring special attention by administrators, supervisors, and work forces. Work should

not conflict with peak flows of traffic.

3. A Traffic Control Plan should be developed early in the project planning stage. The plans, specifications, and estimate for each project should include provisions for a specific Traffic Control Plan, and the plan should include but not be limited to such items as signing; application and removal of pavement markings; construction; scheduling; number and type of traffic control devices; placement and maintenance of devices; roadway lighting; traffic regulations; and surveillance and inspection.

#### **E. Fundamental Principles**

1. Traffic safety in work areas should be planned and conducted with the safety of the motorist, pedestrian, and worker in mind at all times.

2. The goal should be to route traffic through such areas with geometrics and traffic control devices as nearly as possible comparable to those for normal highway situations.

3. Traffic movement should be inhibited as little as practicable.

4. Motorists should be guided in a clear and positive manner while approaching and traversing work areas.

5. Routine inspection of traffic control elements should be performed to insure acceptable levels of operation.

6. The maintenance of roadside safety requires constant attention during the life of the work zone because of the potential increase in hazards.

a. A clear roadside recovery area as wide as practical should be provided to accommodate run-off-the-road incidents, disabled vehicles, or other emergency situations.

b. Traffic control should be accomplished through the use of pavement markings, signs, and channelizing devices, which will yield when hit by errant vehicles.

c. Whenever practical, construction equipment, materials, and debris should be stored in such a manner not to be vulnerable to errant vehicles.

7. All vehicles, equipment, men (except flaggers), and the men's activities are re-

stricted at all times to one side of the shoulder/pavement unless otherwise authorized by the Engineer.

## 5.02 Signs

### A. Design of Signs

1. Street or highway work area signs fall into the same three major categories as do other traffic signs: Warning signs, Regulatory signs, and Informative signs. Existing Regulatory and Warning signs may be appropriate for use in work areas. Many signs normally used elsewhere also can be used for work area operations. Special work area signs follow the basic standards for shapes of all highway signs. Warning signs in work areas shall have a black legend on a yellow background with a red border. Informative signs within work areas may have a black legend and border on a yellow background. Color for other signs shall follow the standard for all highway signs.

2. The dimensions of signs shown in this Manual are for standard sizes, which may be increased wherever necessary for greater legibility or emphasis. The standard sizes would be 900 mm. Where increased sizes are used, these would be 1200 mm.

### B. Illumination and ReflectORIZATION

All signs shall use reflective sheeting or be internally illuminated. Street or highway lighting is not regarded as meeting the requirements for sign illumination.

### C. Position of Signs

1. Signs shall be placed in positions to convey messages most effectively, and placement must be accommodated to highway design and alignment. Signs shall be placed to allow the driver adequate time for response.

2. As a general rule, signs shall be located on the right-hand side of the roadway. Where special emphasis is necessary, dual installations may be made, which consist of duplicate signs opposite each other on the left and

the right sides of the roadway, respectively. Within a work area, however, it is often necessary and/or desirable to erect signs on portable supports placed within the roadway itself. It is also permissible to mount appropriate signs on barricades.

3. Standards for height and lateral clearance of roadside signs are shown in Figure 5-1.

4. Signs mounted on barricades or temporary supports may be mounted at lower heights, but the bottom of the sign shall be not less than 0.5 m above the pavement elevation. However, higher mounting heights are desirable.

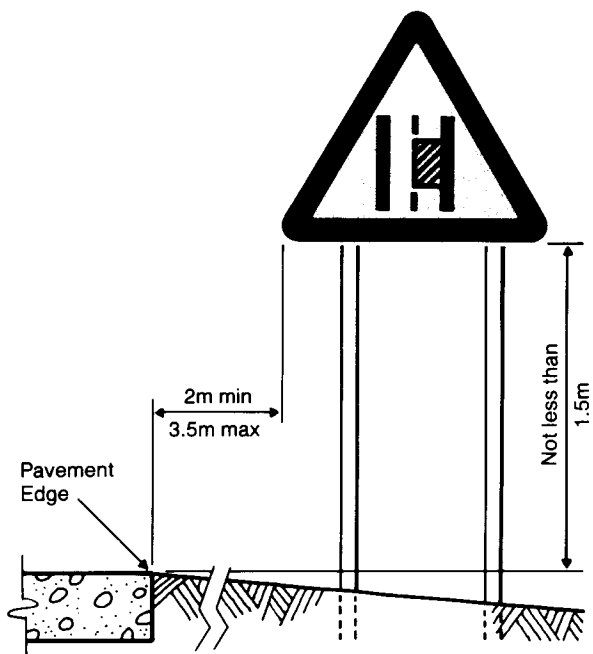
5. Where open highway conditions prevail on the approach to the work area, advance Warning signs should be placed well in advance of the condition. Where a series of advance Warning signs is used, the signs should be placed generally as shown in Cases I through XIII found later in this Part.

### D. Mounting of Signs

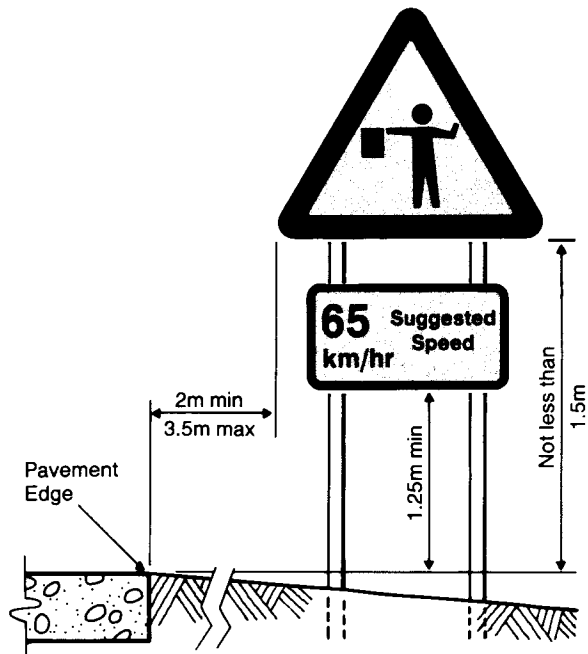
1. Signs on fixed supports are usually mounted on a single post, although those larger than 1 m<sup>2</sup> in area should generally be mounted on two posts. Signs mounted on portable supports are suitable for temporary conditions. All such installations should be constructed to yield upon impact to minimize hazards to motorists.

2. For maximum mobility on certain types of work area operations, a large sign may be effectively mounted on a vehicle stationed in advance of the work or moving along with it. This may be the working vehicle itself or a vehicle provided expressly for this purpose. (See Figure 5-3.)

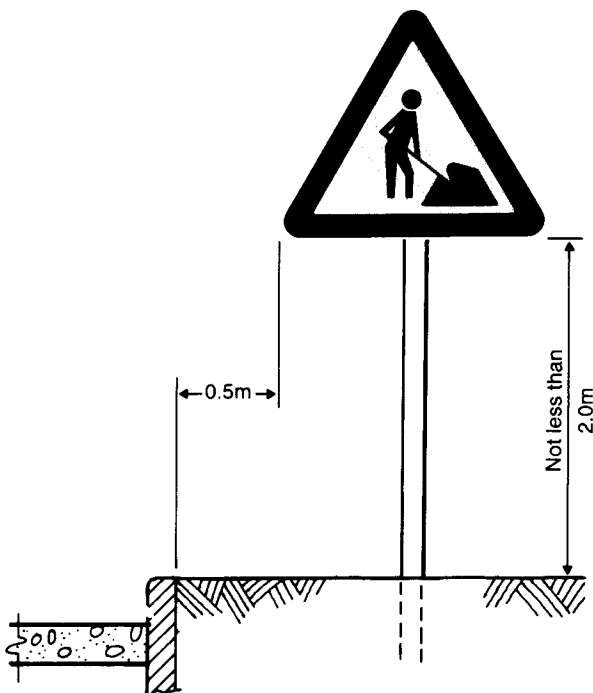
3. Typical methods of mounting signs other than on posts are shown in Figure 5-2.



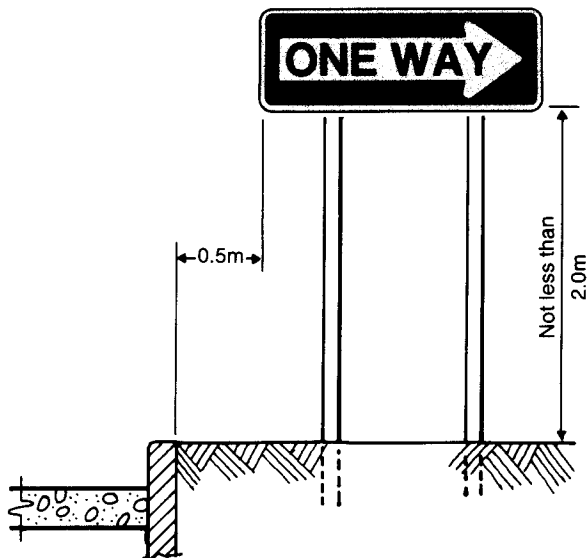
**Rural**



**Rural**

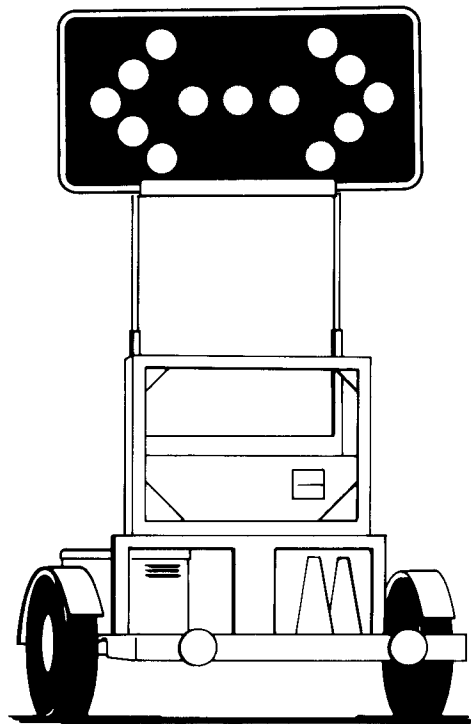


**Urban**

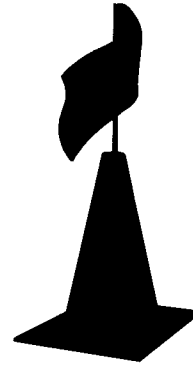


**Urban**

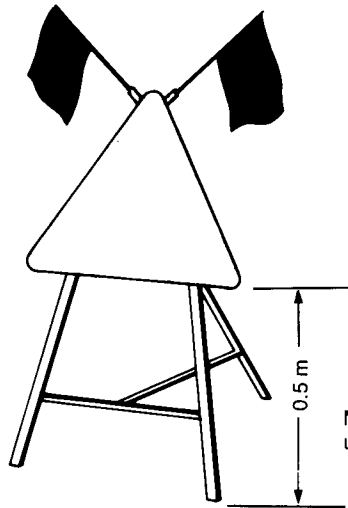
**Figure 5-1**  
Height and lateral location of signs—typical installation.



Sequential Arrow Panel

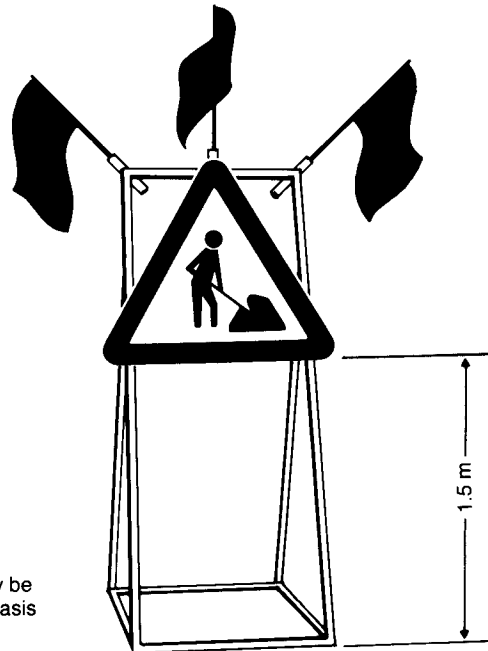


Traffic Cone



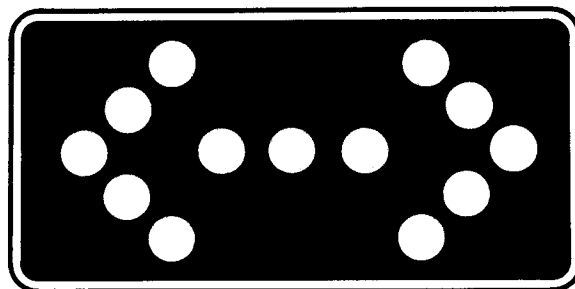
Warning Sign on  
Portable Support

NOTE: Red flags may be  
used for added emphasis



Warning Sign on  
Temporary Support

**Figure 5-2**  
Methods of mounting signs other than on posts.

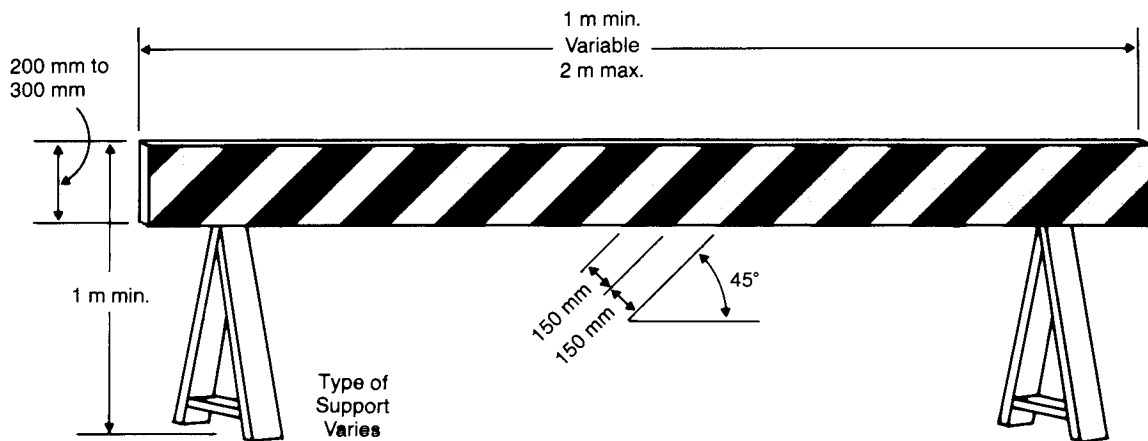


600x1200

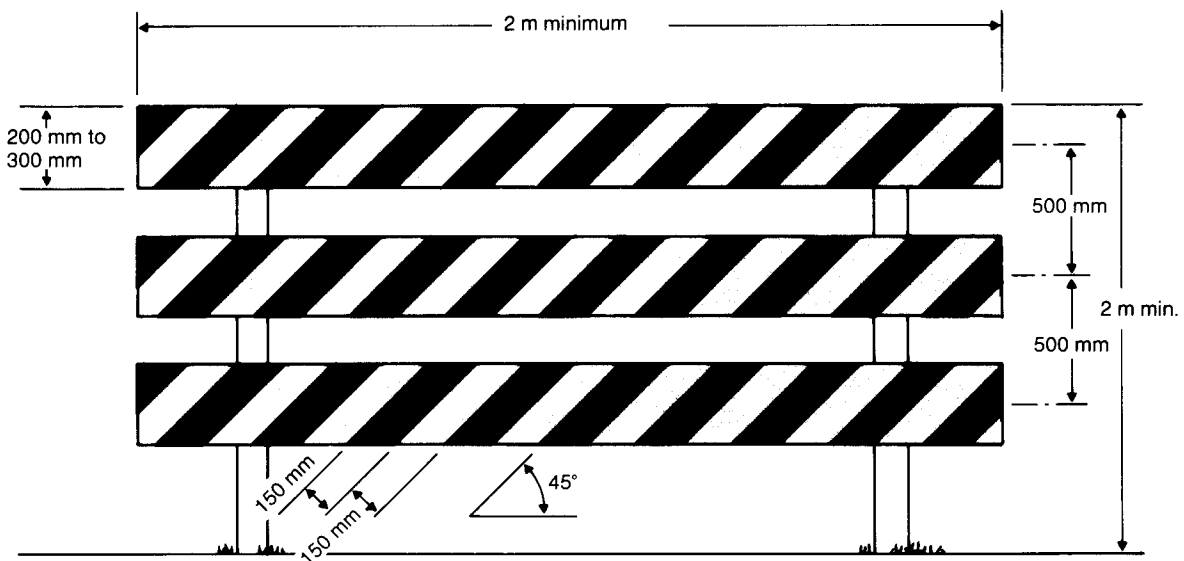
**Figure 5-3**  
Vehicle mounted flashing arrow panel.

# Standard Barricade Types

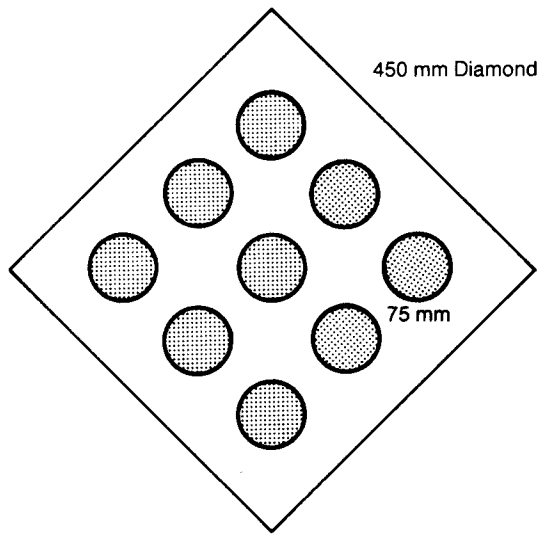
## Type I Barricade



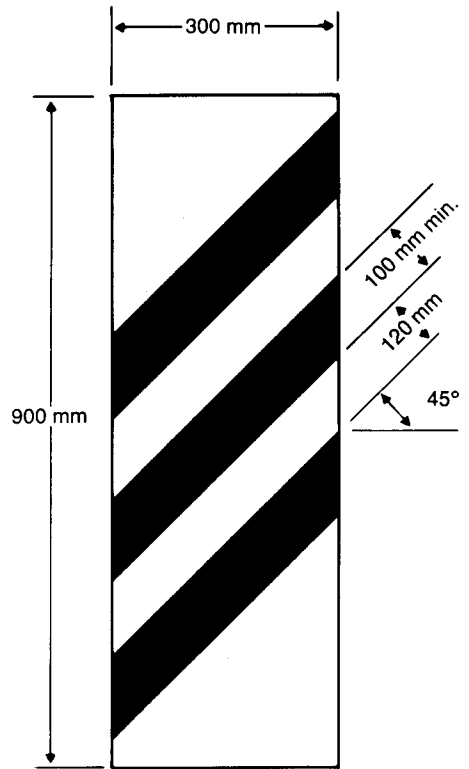
## Type II Barricade



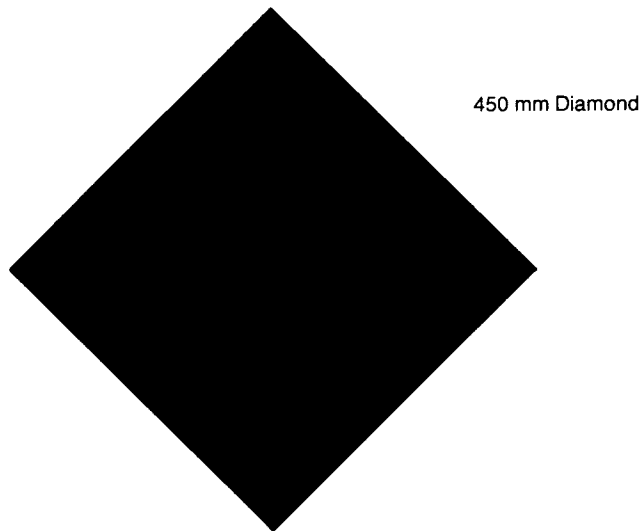
**Figure 5-4**  
**Barricades—Types I, and II**



**a. Type 1**

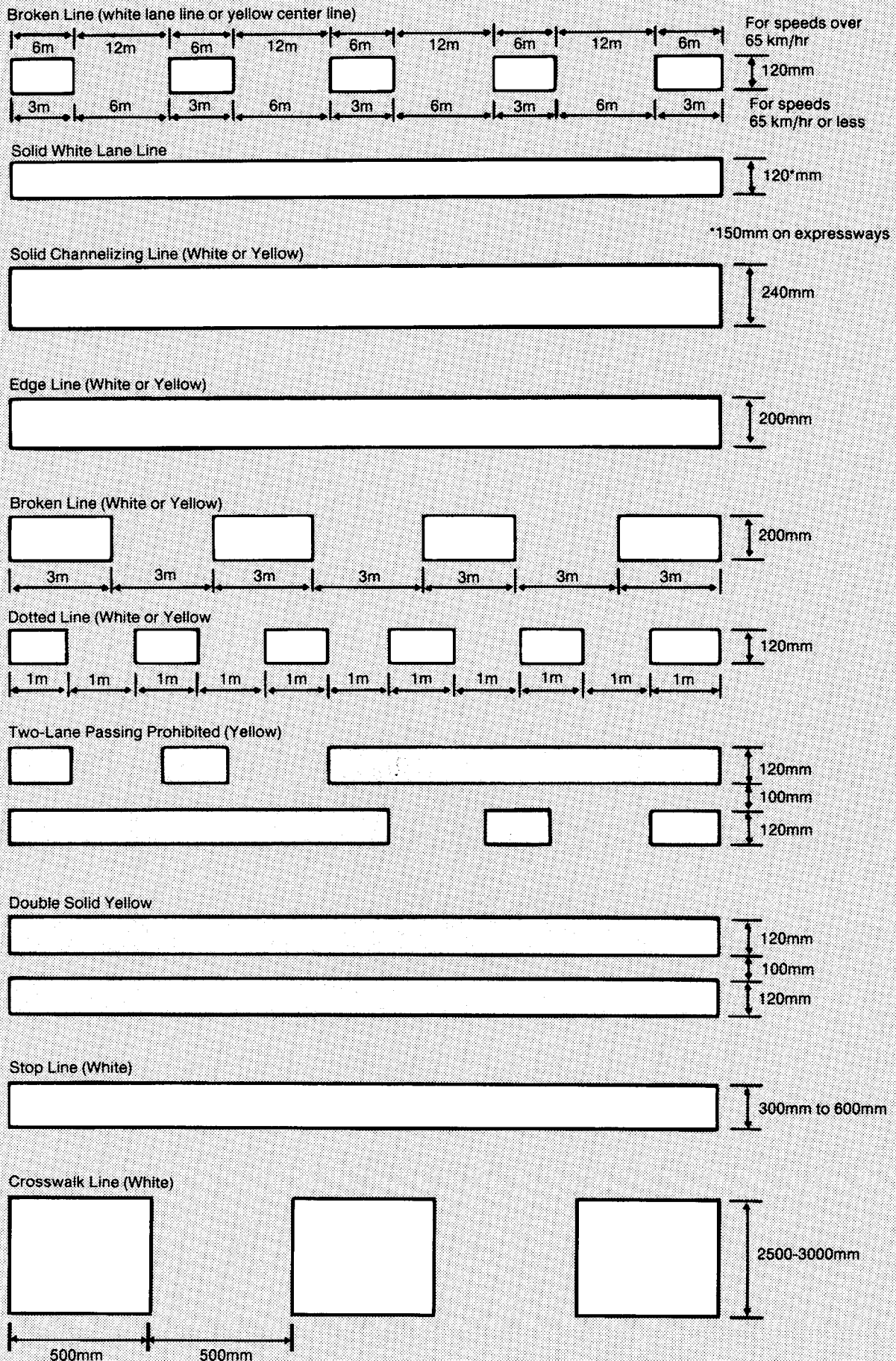


**b. Type 2**



**c. Type 3**

**Figure 5-5  
Object Markings**



**Figure 5-6**  
Typical pavement marking lines and patterns.

## E. Regulatory Signs

### 1. Authority

Regulatory signs impose legal obligations and/or restrictions on all traffic. It is essential that use of these signs be in conformance with the Kingdom's Regulations and this Manual's standards.

### 2. Specific Regulatory Signs

Specific Regulatory signs frequently used in work areas are as follows: Entry Prohibited, Pass This Side, and Priority for Oncoming Traffic.

### 3. Application

Work area operations represent unusual roadway conditions and warrant special attention. If work area operations require regulatory measures different from those normally in effect, the existing permanent regulatory devices shall be removed or covered and superseded by the appropriate temporary Regulatory sign, taking into account applicable regulations of the jurisdiction. (Figure 5-7 illustrates types of Regulatory signs.)

## F. Warning Signs

### 1. Function

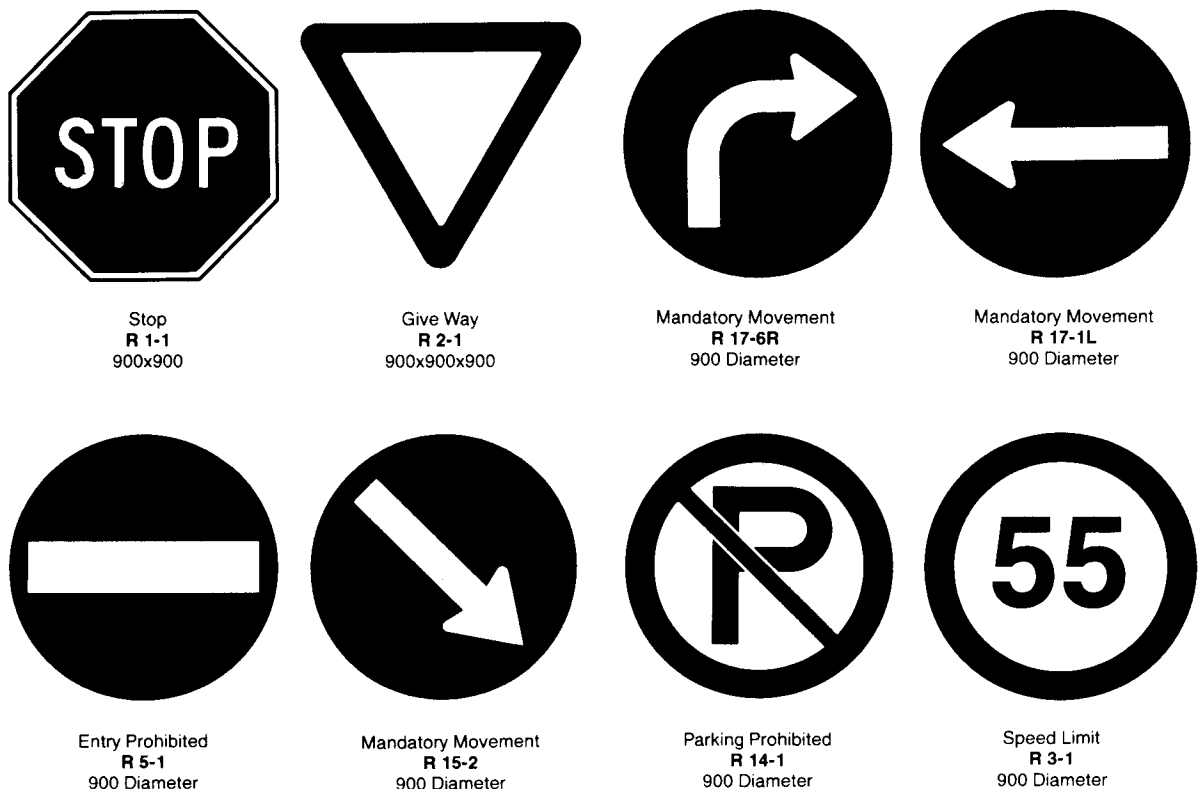
Warning signs for work area projects are used to notify drivers of specific hazards which may be encountered, when those operations are underway. Within the work zone there may be a variety of temporary roadside facilities. Pavement width may be reduced. Open excavations may be present in or near the roadway, or travel across an unpaved section may be required. Drivers should be properly alerted to possible dangers ahead in sufficient time to adjust their speed for the hazard.

### 2. Specific Warning Signs

Specific Warning signs frequently used in work areas are as follows: Road Work, Flagger, Closure, Soft Shoulder, and Two Way Traffic.

### 3. Application of Work Area Approach Warning Signs

- a. Various circumstances will occur which will require extra advance warning

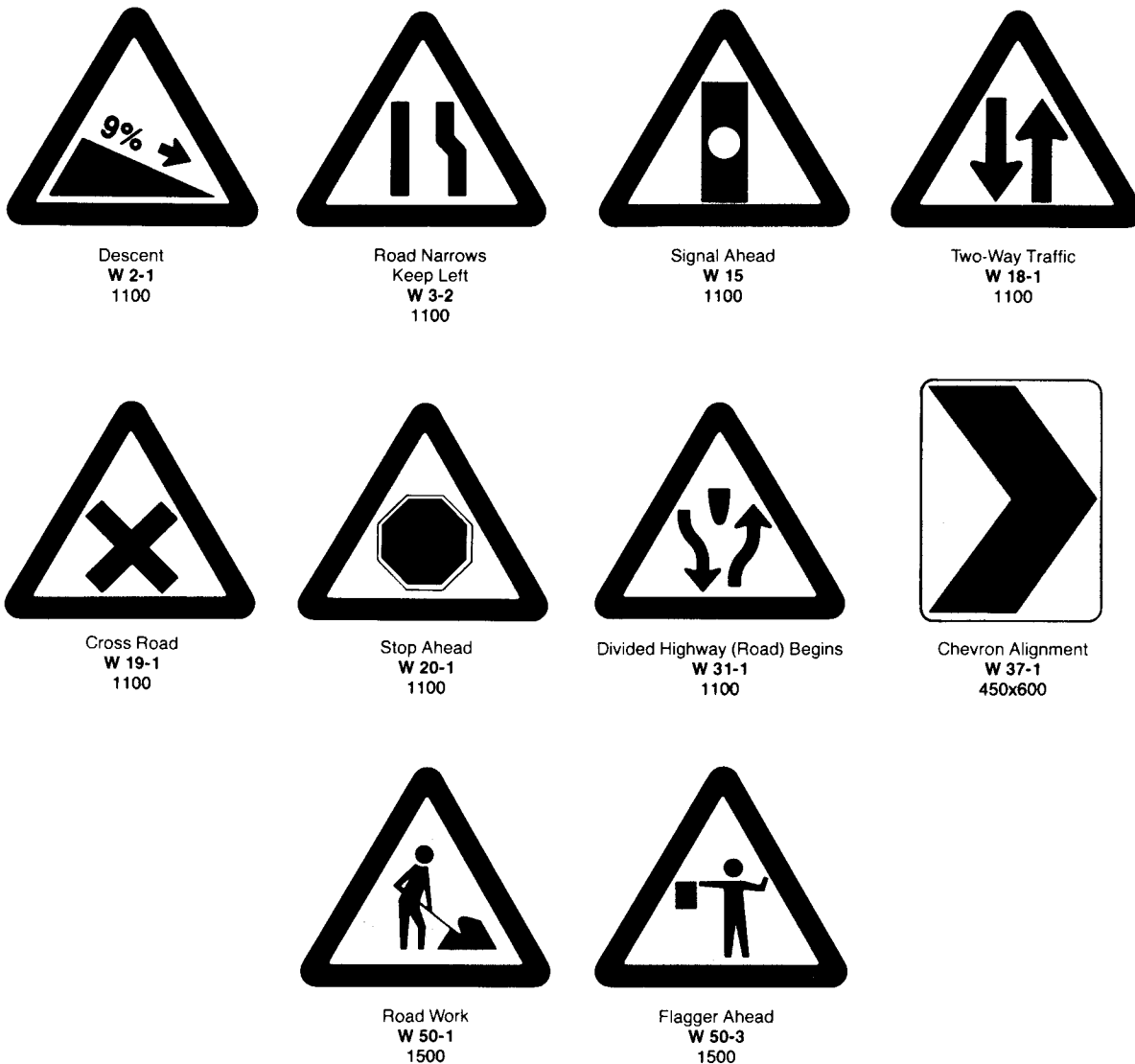


**Figure 5-7**  
**Commonly used regulatory signs.**  
**(Other signs are shown in Part 2—Signs)**

because of limited sight distance or the nature of the obstruction may require a motorist to bring his vehicle to a stop.

b. Construction and maintenance operations for highway and utility work require a large number of standard signs that are

specifically applicable to construction and maintenance activities. These signs shall have a reflectorized yellow background with black message or symbol and red border. Figure 5-8 illustrates several types of advance Warning signs.



**Figure 5-8**  
**Example of Warning signs used in work areas.**  
**(Other Warning signs are shown in Part 2—Signs)**

#### 4. Road Work Sign (W 50-1)

a. The Road Work sign shall be used in advance of major or minor construction, maintenance, or utility operations for the protection of workers in or near the roadway.

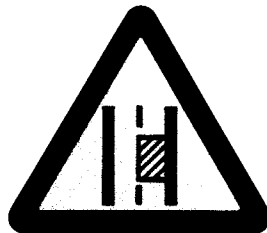
b. When any obstruction is in the traveled way, it may be used in repetition or in conjunction with other construction signs and/or traffic control devices.



Road Work  
W 50-1

#### 5. Lane Closed Sign (W 50-2)

The Lane Closed sign is intended for use in advance of a point where one lane of a two-way roadway is closed. A supplemental sign shall be installed below this sign to indicate the priority for oncoming traffic. Additional protection should be provided by the use of delineators and object markers.



Lane Closed  
W 50-2

#### 6. Flagger Ahead Sign (W 50-3)

a. The Flagger Ahead sign shall be used in advance of any point where a flagman is stationed to control traffic through a construction or maintenance project. It carries the flagger symbol. When needed, an appropriate distance message may be displayed in Arabic on a supplemental plate below the symbol sign. It may be used in repetition or in conjunction with other construction signs and/or traffic control devices.

b. The sign shall be promptly removed, covered, or turned to face away from the roadway whenever the flagger is not at his station.



Flagger Ahead  
W 50-3

#### 7. Dangerous Bend Sign (W 1-1)

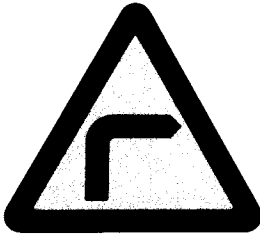
This sign is intended for use where engineering investigations of roadway geometrics and operating conditions show the recommended speed on the curve to be in the range between 50 and 100 km/h and equal to or less than the speed limit established by law. Additional protection may be provided by the use of a Suggested Speed Plate posted below the Curve sign. (W 28-1) Additional curve signs, illustrated in Part 2—Signs, may be used to show other conditions.



Right Bend  
W 1-1R

## 8. Turn Sign (W 1-2)

The Turn sign is intended for use where engineering investigations of roadway geometrics and operating conditions show the recommended speed on a turn to be 50 km/h or less, and this recommended speed is equal to or less than the speed limit established by law. Additional protection may be provided by the use of a Suggested Speed Plate posted below the Turn signs.

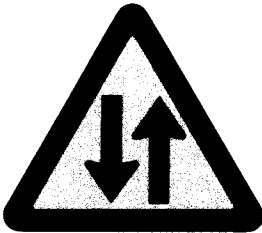


Sharp Bend\*  
W 1-2R

\*Other Bend Signs  
shown in Part 2-SIGNS

## 9. Two-Way Traffic Sign (W 18-1)

The Two-Way Traffic sign should be used as needed at approximately 3 km intervals in both directions to periodically remind drivers they are on a two-way highway with traffic flowing in both directions.



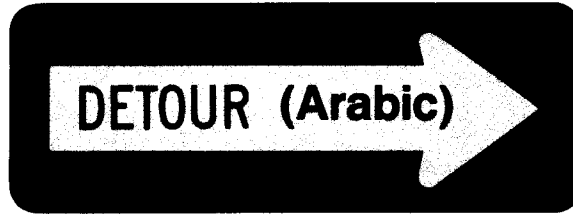
Two-Way Traffic  
W 18-1

## 10. Detour Arrow Sign (I 20-1)

a. The Detour Arrow sign is used at a point where a detour roadway or route is established because a street or highway is closed to through traffic.

b. The Detour Arrow sign uses, at each location, a horizontal arrow pointed to the right or left as required. DETOUR shall be written in Arabic and English beside each other on the surface of the yellow arrow.

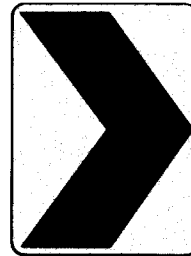
c. Each detour shall be adequately marked with standard detour and destination signs.



Detour Arrow  
I 20-1  
500x1500  
1000x3000

## 11. Chevron Alignment Sign (W 37-1)

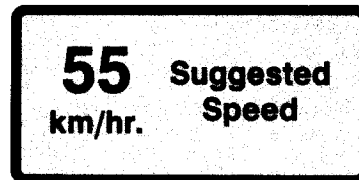
Chevron Alignment signs may be used to supplement pavement markings and raised reflective pavement markers. It is intended to provide additional emphasis and guidance for motorists, concerning changes in the horizontal alignment of the roadway.



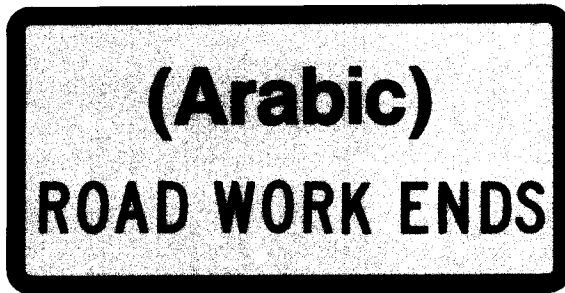
Chevron Alignment  
W 37-1  
450x600

## 12. Suggested Speed Plate (W 28-1)

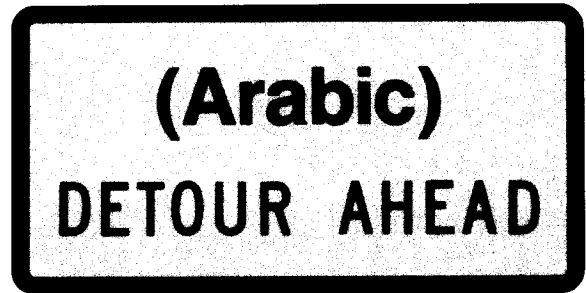
In conjunction with a Warning sign, a Suggested Speed Plate may be used to indicate a maximum recommended speed through the construction or maintenance area. This plate shall have a black legend on a yellow background. Recommended speeds are to be posted in Arabic only.



Suggested Speed  
W 28-1  
(450x900)



End Road Work  
I-5  
500x1000



Detour Ahead  
I 4-1

## G. Information Signs

### 1. General

Information signs should be designed to be easily readable, permitting drivers to make timely and proper responses. This means high visibility, large lettering, and short legends for quick comprehension. Standard shapes and colors are required so the signs can be promptly recognized.

### 2. Specific Informative Signs

Specific Informative signs used in work areas include signs which relate to the Detour Ahead.

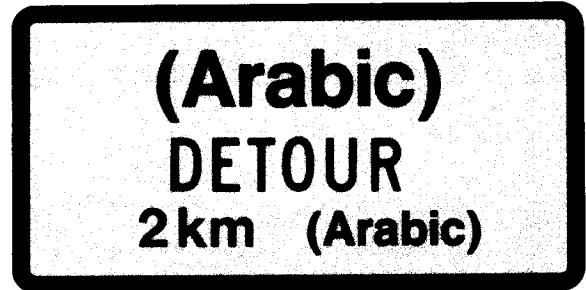
### 3. Application

The application of Informative Signs are listed in Part 2—SIGNS.

### 4. Detour Ahead (I 4-1)

#### Detour 2 km (I 4-2)

The Detour Ahead sign shall be used in advance of the point where traffic is diverted over a temporary roadway or route. It carries the legend DETOUR AHEAD in Arabic and English. It can also have the message DETOUR 2 km to indicate the kilometers to the detour. The sign may be used in conjunction with other construction signs and/or traffic control devices.



Detour 2 Km  
I 4-2

### 5. End Road Work Sign (I 5)

The End Road Work sign shall be erected approximately 200 meters beyond the end of a construction or maintenance operation. The legend shall appear in Arabic and English.



## 5.03 Temporary Channelization and Devices

### A. Temporary Channelization

1. The purpose of channelization is to guide drivers past hazards caused by construction and maintenance operations. Channelization should be designed so traffic can move easily and smoothly in the required direction without sharp turns. Where channelizing devices are used on both sides of a traffic lane, separation between the devices should accommodate the largest vehicle without allowing space for two lanes of smaller vehicles.

2. Any change in direction of width of travel lane should be preceded by proper warning devices, such as signs and beacons. These should be of a size, number, and placement appropriate to the physical conditions and speed of traffic.

3. Where two-way traffic is being operated on one roadway of a normally divided highway, opposing traffic in adjacent lanes shall be separated by a portable barrier (Section 5.03 F), or with drums, cones, tubular markers, or vertical panels. Such devices may have to be fastened to the pavement to prevent the devices from being blown or knocked into the adjacent lane.

4. The taper (rate at which traffic is required to move laterally for each 100 m of longitudinal travel) is one of the most critical elements in the design of traffic control and guidance in work areas. If drivers are required by the channelization to move too quickly to the right or left, traffic congestion and accidents are almost certain to result. Numerous studies have been made to determine a safe and comfortable rate for the lateral movement of traffic. Based upon these studies, it has been determined that the following two formulas should be used in computing taper rate for work areas:

$L = \frac{WS^2}{155.4}$  where the speed limit is less than 70 km/h

$L = \frac{WS}{1.61}$  where the speed limit is 70 km/h or more

where L = total length of the taper section (meters)

W = lateral distance traffic is to be moved (meters)

S = speed limit or 85 percentile speed (km/h)

5. Table 5-1 gives the taper lengths for normal speeds and the lateral distance traffic is to be moved. The distances in the table apply where reasonably flat grades and straight or only moderately curved alignment occurs. Conditions such as poor sight distance, a considerable downgrade, crossroads or ramp areas may necessitate an increase in these taper lengths.

6. It is important the spacing of channelizing devices on the edges of tapers give motorists the impression of a continuous guiding line. Table 5-2 gives the maximum spacing of channelizing devices in tapers. Table 5-3 gives their spacing on bends. (Note that the latter table relates spacing to the radius of curvature of the bend.) When the channelization is on a bend, whichever table gives the shorter spacing should be used. A shorter spacing may be necessary if it is found drivers are going between the channelizing devices. A brief period of observation of motorists as they drive through a channelized area will often show if the length of taper and spacing of the devices are adequate.

Table 5-1

Taper Lengths in Meters for Required Lateral Movement

Speed km/h	Distance in Meters Traffic is to be Moved R or L						
	1.5	2.5	2.75	3.0	3.25	3.5	3.75
30	9	15	16	17	19	20	22
35	11	20	22	24	26	28	30
40	15	26	28	31	34	36	39
45	20	33	36	39	42	46	49
50	24	40	44	48	52	56	60
55	29	49	54	58	63	68	73
60	35	58	64	70	75	81	87
65	41	68	75	82	88	95	102
70	65	109	120	131	141	152	163
75	70	117	128	140	152	163	175
80	75	124	137	149	162	174	186
85	79	132	145	158	172	185	198
90	84	140	154	168	182	196	210
95	89	148	162	177	192	207	221
100	93	155	171	186	202	218	233
105	98	163	179	196	212	228	245
110	103	171	188	205	222	239	256
115	107	179	197	214	232	250	268
120	112	184	205	224	242	261	280

**Table 5-2**

**Spacing of Channelizing Devices in Tapers**

Posted or 85 Percentile Speed (km/h)	Spacing of Channelizing Devices (m)
30	6
40	8
50	9
60	11
70	13
80	15
90	17
100	19
110	21
120	23

These spacings are for large (approximately 90 cm) cones, 30 cm × 60 cm vertical panels, and Type I and II barricades. Spacings should be only one-half of those shown when small (45 cm) cones are used. This does not apply to portable barriers. A shorter spacing may be necessary if it is found that drivers are going between the channelizing devices.

**Table 5-3**

**Spacing of Channelizing Devices on Bends**

Radius of Bend (m)	Spacing of Channelizing Devices (m)
25	7
50	10
75	12
100	15
125	18
150	20
175	21
200	22
250	25
300	27
400	33
500	36
Over 500	50

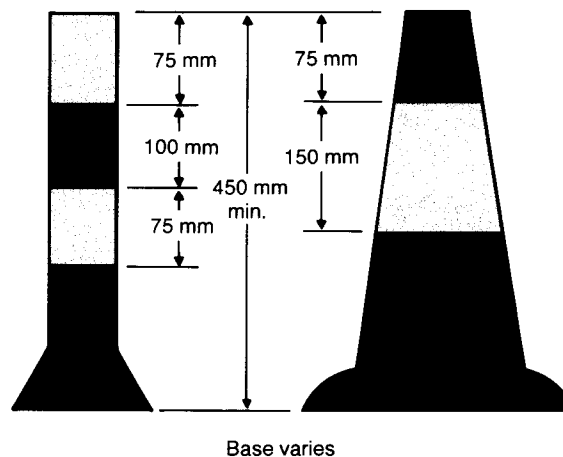
Does not apply to portable barriers. A shorter spacing may be necessary if it is found drivers are going between the channelizing devices.

## B. Traffic Cones and Tubular Markers

1. Traffic cones and tubular markers of various types are available. Cones and tubes, including the bases, shall be made of material which will withstand impact from vehicles without damage to cones or tubes or the vehicles. Cones and tubes shall have a minimum height of 450 mm and shall have a square base wide enough to prevent their being overturned and rolled into a traffic

lane by the rush of air caused by passing vehicles. Larger and taller cones and tubes shall be used on roadways where speed is high and more conspicuous guidance is needed.

2. Red shall be the predominant color of cones and tubes. It is usually best to use cones and tubes made from red-colored material rather than having the red color applied to the outer surface of the cone or tube. Tubes and cones shall be reflectorized and should be kept reasonably clean and bright for maximum target value. Cones shall have a yellow-colored reflectorized band at least 150 mm in width placed no more than 75 mm from the top of the cone. Tubular markers shall have two yellow-colored reflectorized bands, each at least 75 mm in width, spaced approximately 100 mm apart. The top band shall be not more than 75 mm from the top of the tube. As an alternative, the entire cone or tubular marker may be reflectorized with red-colored reflecting material.



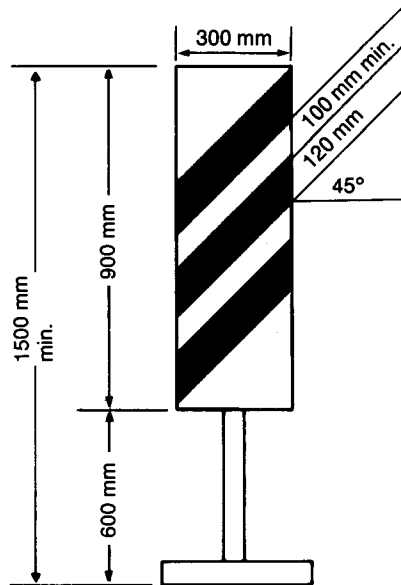
3. Traffic cones may have a weighted base but it should not be heavy or hard enough to damage a vehicle which strikes it. One cone may be placed over another for added weight where necessary. Tubular markers must be attached to the roadway.

4. Since cones and tubular markers can easily be overturned or knocked aside, placement should be inspected frequently to assure the cones or tubes remain in proper position.

## C. Vertical Panels

1. Vertical panels are warning devices having reflectorized red stripes on a reflectorized yellow background and are used for delineation or channelization of

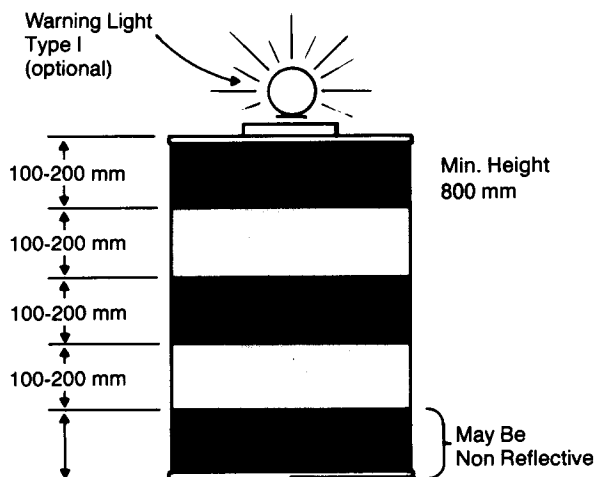
be 300 mm in width and shall have a vertical dimension of 900 mm. Vertical panels are placed on a post or other suitable support with the top at least 1.5 m above the level of the adjacent roadway. The details of size, pattern, and mounting height are as illustrated. Vertical panels are used for traffic separation or shoulder barricading where space is at a minimum.



2. Warning lights may be placed at night on these panels as described in the section on lighting.

#### D. Drums

1. Drums are cylindrical containers used for channelization or delineation. Drums shall have a minimum height of at least 800 mm and a minimum diameter of at least 500 mm. The markings on each drum shall consist of at least two horizontal reflecting yellow and two red bands which completely encircle the drum. Each such band shall be between 100 mm and 200 mm in width and if there are non reflectorized bands between the horizontal red and yellow stripes, they



shall be a maximum of 50 mm wide. Only plastic drums may be used. The standard size, colors, and banding of drums are as illustrated. The red and yellow bands shall be reflectorized with a material that has a smooth, sealed outer surface, which will have approximately the same color both day and night.

2. Drums shall not be weighted with rocks, concrete, asphalt, sand or any other substance to the extent drums become hazardous to motorists if struck. Generally no more than 250 mm of sand or similar material in the bottom of a drum will be sufficient to prevent it from being moved by the wind from passing vehicles. Each drum should have drain holes in its bottom to release accumulated water.

3. Where drums are placed in the roadway, advance warning signs shall also be used.

4. During the hours of darkness, warning or delineation lights may be placed on drums in the manner described in Section 5.05 of this Manual on lighting in work areas. Arrow signs may be mounted on the top of drums where necessary.

#### E. Barricades

##### 1. Design

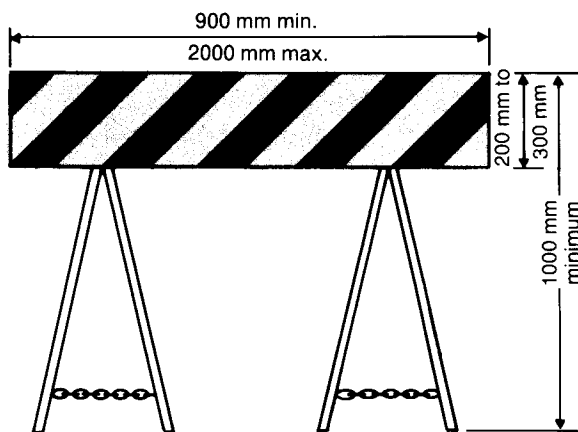
a. A barricade is a fixed or portable device made from wood, light metal, or plastic, having either one or three horizontal members. Barricades are designated as being Type I or Type II. The physical dimensions, stripes, and colors are shown in Table 5-4 and the illustration. The entire area of red and yellow shall be reflectorized with a material which has a smooth, sealed outer surface, which will have approximately the same color day and night. The supports for a barricade should not be reflectorized. However, the supports should be white except that light gage, unpainted galvanized iron or aluminum components may be used.

b. Barricade rails should be flat. The supporting members may be of any appropriate design provided the supports hold the barricade rails in the required position and relation to each other. The supports must also hold the barricades in place during normal storms and the wind from passing vehicles. Both the reflectorized rails and supporting structure should be constructed so that if hit by a vehicle, no serious damage occurs to the vehicle or harm to the occupants.

**Table 5-4**

**Barricade Characteristics**

Characteristic	Type I	Type II
Width of Rail	200-300 mm	300 mm
Length of Rail	900 mm Min.	1.5 m Min.
Height	1 m Min.	1.5 m Min.
Number of Reflectorized Rail Faces	2 (one to each direction)	3 (if facing traffic in one direction) 6 (if facing traffic in two directions)

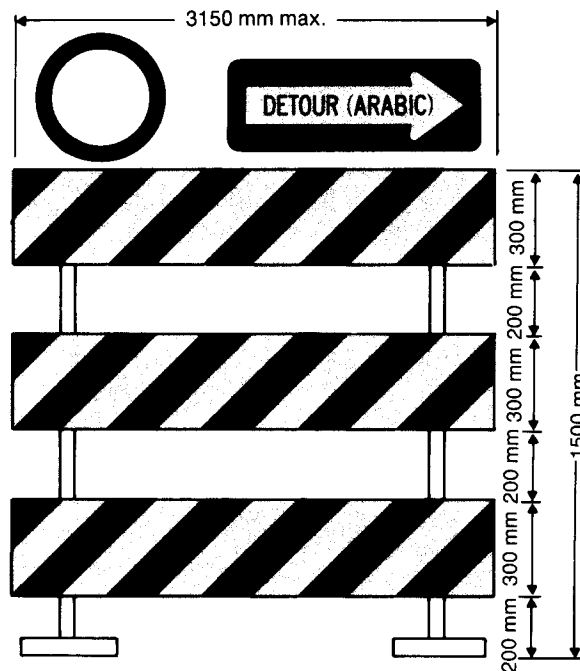


Type I Barricade Channelizing Device

## 2. Use

a. Because of its height and area, barricades might be overturned by wind and the rush of air from passing vehicles, especially trucks. To prevent barricades from being overturned, sandbags may be placed on the lowest parts of the frame. Stones, pieces of concrete or asphalt and similar hard, heavy articles shall not be used for this purpose. Barricade supports constructed of tubular materials may have ballast added to the hollow components at the bottom of the barricade. Sandbags, stones, concrete, or heavy articles shall never be placed over any reflectorized rail.

b. When used to channelize traffic, barricades should be placed essentially at right angles to the movement of traffic. Barricades should not be placed parallel to traffic because that would greatly reduce its visibility, especially at night.



Type II Barricade Road Closures

*Note: See Figure 5-4 for detailed design of Type I and Type II Barricades.*

c. When a road section is closed to traffic, Type II barricades shall be erected across the road at all points of access to the closed section. When provision must be made for access of authorized traffic to the closed section, the barricade may have a gate or moveable section. A responsible person must be assigned to assure the barricades are closed at night or whenever access is not allowed. Sometimes a road section must be closed to through traffic but will remain open to local traffic. In these cases, the Type II barricades are usually set so only one lane leads into the closed section. Suitable signs warning of the road closure and allowing use of the road only by local traffic should be erected on the barricade.

d. Barricades may be placed in a sequence on each side of the road, starting at the outer edge of the shoulder and becoming

progressively closer to the pavement. This gives motorists the illusion of the narrowing of the roadway which alerts and tends to slow them. During periods when barricades are not needed, the barricades should be removed or turned to face away from the road.

e. Signs may be placed on barricades as illustrated. When practicable, the bottom of signs on barricades shall be not less than 500 mm above the adjacent traveled way. The Road Closed sign may be mounted on a Type II barricade which is used to close a road.

f. Flashing or steady warning lights may be placed on all types of barricades when used at night. Flashing Type A or Type B warning lights should be used only to warn of a hazard on or immediately adjacent to the roadway. Steady burning Type C lights should be placed on barricades used for delineation. However, Type A flashing warning lights may be used on the first two barricades or drums used in a series for delineation.

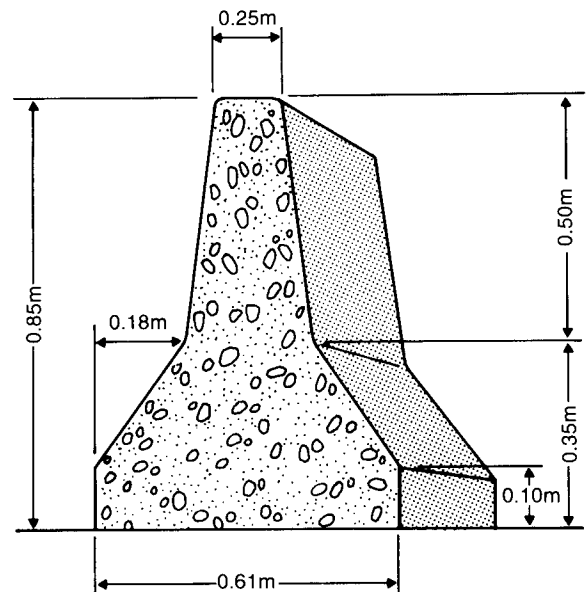
g. Sidewalks and roadways may be closed with barricades. Where the proper alternate path for pedestrians is not clearly evident, or where it is necessary to protect pedestrians from vehicular traffic, Type I barricades should be used. These barricades should be placed parallel to the pedestrian path to delineate it. Unless adequate illumination is present, steady-burning warning lights should be placed at intervals along such barricades.

## F. Portable Barriers

1. Portable barriers are devices intended to prevent vehicles from leaving the roadway/shoulder area at that point. These barriers are also used to channelize traffic, to separate two-way traffic which is on adjacent lanes and prevent vehicles from hitting roadside objects or workers. The barriers should be designed to redirect impacting vehicles with as little injury to the occupants or damage to the vehicle as possible.

2. Portable barriers are designed to be used for a time at one site and then moved to another site for use. They may be made of reinforced concrete, metal, or any material designed to be strong enough to withstand the forces generated by impacting vehicles. When used in work areas, adjacent barrier sections shall be strongly connected to each other. If practicable, barriers may also be fastened to the surface upon which they rest.

3. When used for channelizing traffic, portable barriers shall be light-colored for increased visibility and shall have a reflective delineator with a minimum area of not less than 100 cm<sup>2</sup> mounted on the top of each barrier segment. In curved or narrowed transition areas, other reflectorized delineation devices, such as vertical panels or barricades may be needed for greater visibility. Warning lights, as described in Section 5.05, may be used to provide added delineation. Portable barriers should be considered for use at the beginning of a zone, which must be operated with two-way traffic on one roadway of a normally divided highway.



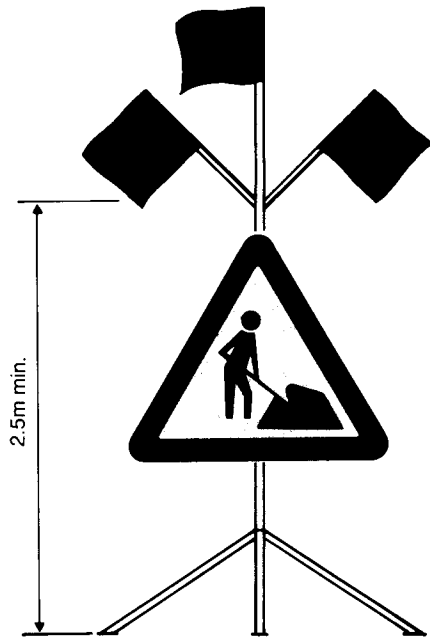
Portable Concrete Safety Barrier

4. The start of a section of portable barrier would be a serious hazard unless precautions were taken to prevent the unguarded vertical face of the barrier from being hit by vehicles. Where practicable, the leading end of the barrier should be flared out from the edge of the roadway and fitted with a sloping terminal section. As an alternative, a crash cushion can be placed at the beginning of a portable barrier.

## G. High Level Warning Devices

1. High level warning devices consist principally of three or more red flags on a tall support. These devices should be high enough to be seen over the tops of preceding passenger vehicles. When night visibility is required, a Type B high intensity flashing warning beacon shall be mounted on the support at the base of the flags. An appropriate warning or other sign may also be attached to the support at the correct height.

2. The flags shall be not less than 40 cm square and shall be red in color. A typical high level warning device is as illustrated.



High Level Warning Device

## 5.04 Markings

### A. Materials

1. Pavement markings are an important device for guiding and directing traffic in work areas. Markings are used in combination with warning signs, channelizing devices, and delineators to clearly indicate vehicle paths.
2. Pavement markings include paint, hot or cold thermoplastics, epoxies, polyesters and similar material, pressure sensitive reflective tape, and raised pavement markers. Raised pavement markers are almost always used to supplement other types of pavement markings.
3. The type of material used will depend upon how long the marking will be needed and amount of traffic using the roadway. When the pavement marking will have to be removed after the work is completed, reflective tape is generally the preferable material as it is usually much easier to remove than the other materials. Raised pavement markers are also easy to place and remove, and can be used in such cases to supplement the tape. Any of the materials, referred to in paragraph 2, above, can be used on temporary roadways which will be removed when the work has been completed.

### B. Types and Uses

1. Temporary center line marking on a two-lane, two-way highway where passing is allowed consists of a yellow stripe 6 m in length followed by a gap of 12 m. The stripe shall be 120 mm in width. On multi-lane undivided highways, the center line marking is two continuous yellow lines 120 mm in width separated by a space 100 mm in width.
2. Where the temporary vehicle path in a work area includes adjacent lanes for vehicles moving in opposite directions, No Passing markings for traffic in both directions will frequently be required. These markings consist of two parallel 120 mm wide yellow lines separated by a space of 100 mm in width. No Passing markings are normally required at the transition from the regular roadway to the temporary lanes required by the construction work.
3. Edge lines are equally important and should be applied to the right and left of a temporary roadway whenever pavement markings are used. Edge lines are continuous white lines 200 mm in width placed just within the pavement edge.
4. When two or more lanes for traffic in the same direction are being relocated, lane lines

as well as edge lines shall be placed. Raised reflective pavement markers on edge and lane lines should also be considered in such cases.

5. Previous pavement markings that might confuse or misdirect motorists shall be removed or obliterated, preferably before traffic has been re-routed. Removal or obliteration should be done in such a way as to leave a minimum of scars on the pavement. Painting over existing stripes does not meet the requirement for obliteration as the over painting will wear off and expose the original paint. However, existing markings may be overpainted or covered with reflecting tape in an emergency until removal can be accomplished or for very short periods.

6. Whenever possible, pavement markings as well as other necessary devices should be placed before traffic is moved onto a new travel lane. This applies not only to temporary lanes necessitated by construction, but also the final pavement when it is ready to be opened to traffic.

7. In work areas, motorists need more than the usual amount of warning, guidance, and delineation. For this reason, pavement markings should be placed on roadways in work areas wherever markings exist on the adjacent sections of undisturbed highway. Generally, pavement markings are not required in work areas on urban streets except those carrying large traffic volumes.

8. On resurfacing projects where traffic is maintained, temporary center and lane lines shall be installed prior to terminating the work each day. These temporary pavement markings shall consist, as a minimum, of a 3-meter segment of line approximately 120 mm wide with 12-meter gaps. It is recommended a temporary marking tape or temporary raised pavement markers be used to provide these markings.

9. Pavement markings are not appropriate for situations in which the path of vehicles will be changed at frequent intervals, for example, more often than every 2 or 3 days. In such situations, delineation of the temporary vehicle paths can be accomplished by channelizing devices such as cones or barricades. For this reason, pavement markings are normally not used in maintenance work areas.

### C. Delineators

1. Delineators are retro-reflective devices, which can be seen in darkness under normal atmospheric conditions from a distance of

300 m when illuminated by the upper beam of standard automobile headlights located at the point of observation.

2. The reflective element of a delineator shall have a minimum area of not less than 100 cm<sup>2</sup>.

3. Delineators, when used, shall be mounted on suitable supports so the reflecting unit is approximately 1.2 m above the near pavement edge. Delineators shall be placed between 1 m and 2 m outside the outer edge of the berm or in the line of a guardrail, if used. The color of the reflecting element of delineators shall be white. Delineators should be spaced along the roadway in accordance with Tables 5-2 and 5-3. Delineators

on portable barriers shall be spaced as specified in paragraph 5.03 F3.

4. Delineators may be used in work areas and on detours to indicate the alignment of the roadway and outline the required vehicle path. Delineators shall not be used alone or in groups to warn of hazards. Delineators may have value on detours where the road is curving and frequent bends occur. Delineators are customarily used on roadway sections which may be traveled at or near normal speed. Barricades and similar channelizing devices rather than delineators are to be used in areas where traffic is being diverted from its normal path, or where more than usual hazard exists because of adjacent traffic, excavation, or other work.

## 5.05 Lighting Devices

### A. Battery-Operated Warning and Delineation Lights

1. These warning lights are portable, battery-operated lights with a plastic lens which gives a yellow light. These lights are intended for use on maintenance and construction work with Warning signs, barricades, drums, reflecting panels or other devices. Three types are used:

- a. Type A is a low brightness flasher.
- b. Type B is a high brightness flasher.
- c. Type C gives a steady light.

2. Warning and delineation lights shall be attached by vandal-resistant fasteners to warning and channelization devices. Type A and C lights shall be designed to automatically turn off during the daylight hours.

3. When the lights are placed on barricades, the lights shall be mounted with the bottom of the lens approximately 1 m above the ground.

4. Battery-operated warning lights shall meet or exceed the requirements in Table 5-5.

5. Type A low brightness flashing warning lights are most frequently attached to barricades, drums, vertical reflecting panels, and supports for Advance Warning signs. Type A is intended to call attention to the device, and warn drivers they are approaching or passing through a hazardous area. Type A flashing lights shall not be used on barricades and similar devices which are being used for delineation purposes.

6. Type B high brightness flashing warning lights are normally used with the first Advance Warning signs on the approach to a work area. Type B may also be used with barricades, signs, and other supports where extremely hazardous conditions exist within a work area. These lights are bright enough to be effective during the day as well as night and are designed to operate at all times.

7. Type C steady burning lights are intended to supplement reflective panels and longitudinal barricades to delineate the path which vehicles should follow through a work area.

### B. Hazard Identification Beacons

1. A Hazard Identification Beacon is a type of traffic signal giving a flashing YELLOW ROUND indication. It shall be used only to supplement an appropriate Warning or Regulatory sign. The beacon shall operate whenever the hazard exists. The beacon and sign shall be removed, covered, or turned away from the road when not needed.

2. A Hazard Identification Beacon shall have a yellow lens with a visible diameter of at least 200 mm and, preferably, 300 mm. The beacon shall be mounted above the sign with a clearance from the sign of between 300 mm and 400 mm. The beacon shall flash at a rate of not less than 50 nor more than 80 times per minute. The illuminated period shall be not less than one-half nor more than two-thirds of the total cycle. A lamp having a nominal minimum rating of 600 lumens shall be used with the smaller lens and a lamp having a nominal minimum rating of 1750 lumens with the larger lens.

Table 5-5

Warning Lights

Characteristics	Type A Low Brightness	Type B High Brightness	Type C Steady Burn
Lens Directional Faces	1 or 2	1	1 or 2
Flashing Rate per Minute	55 to 75	55 to 75	Do not flash
Flash Duration <sup>1</sup>	10%	8%	Do not flash
Minimum Effective Visibility	1000 m (Night)	350 m (Sunny Day)	1000 m (Night)
Minimum Lens Diameter	15 cm	15 cm	15 cm
Hours of Required Operation	Dusk to Dawn	All Times	Dusk to Dawn

<sup>1</sup>Length of time instantaneous brightness is equal to or greater than effective brightness.

3. A Hazard Identification Beacon may consist of a single flashing unit placed above a sign, or it may have two flashing units. In this case, one flashing unit is placed above the sign, and the other is placed below the sign. When the sign and beacons are over the roadway and the width of the sign exceeds its height, the flashing units may be aligned horizontally. The flashing indications shall be alternately illuminated.

4. A Hazard Identification Beacon is usually a single section of a traffic control signal head, operating from a 110 or 220 volt alternating current power source. The beacon should be connected to a power main if practicable but may be operated from a portable electric generator if its reliability can be assured.

5. A Hazard Identification Beacon may also be a self-contained unit consisting of flasher, power source and sign, generally mounted on a small trailer for easy transport. The beacon is operated from batteries or an electric generator on the trailer. Most units have racks or other devices for holding the Warning and Regulatory signs which shall be used with these devices.

6. Trailer-mounted Hazard Identification Beacons are useful for giving warnings in advance of work sites on all classes of highways. These beacons are especially adaptable to being towed slowly along a highway to give advance warning of moving maintenance operations.

7. The signs and flashing lights on trailer-mounted Hazard Identification Beacons may be mounted at less than the normal height above the roadway provided the beacons are adequately visible to approaching traffic. The lens size, color, light distribution, brightness, rate and duration of flash, however, shall conform to the general requirements for Hazard Identification Beacons.

**Table 5-6**

**Warning Flashing Arrow Panels**

Type	Minimum Size (mm)	Minimum Number of Panel Lamps	Minimum Legibility Distance (km)
A	600 × 1200	12	0.80
B	750 × 1350	13	1.25
C	1200 × 2400	15	1.50

### **C. Flashing Warning Arrow Panels**

1. Flashing Warning Arrow Panels are useful devices to supplement Warning signs. These

panels are used primarily where traffic volume is heavy and approach speeds are high. The panels also may be used for roadway or lane closures, or for slow moving maintenance and construction operations on the roadway. These panels are used at or in advance of the point where traffic is required to turn or leave its normal path.

2. Flashing Warning Arrow (Chevron) Panels consist of yellow light units arranged in the shape of an arrow or chevron on a rectangular panel with a matte black background. The lights all flash simultaneously giving a flashing arrow or chevron effect.

3. Flashing Warning Arrow (Chevron) Panels shall meet the requirements in Table 5-6.

4. Type A Flashing Warning Arrow Panels should normally be used on local and collector streets and highways, particularly where traffic volume is moderate and traffic speed is not great. Type B panels should be used on arterial streets and highways, and expressways. Type B also may be desirable on some local and collector streets and highways. Type C panels are intended for use on heavily traveled expressways and for any situation where the combination of vehicle speed and volume, especially with poor roadway geometrics, requires the best warning devices available.

5. The minimum legibility distance requirement in Table 5-6 is the distance at which the direction in which the arrow is pointing can be reliably determined by an average driver on a sunny day or a clear night.

6. Arrow panels shall be capable of giving each of the following four indications:

- a. Left arrow only.
- b. Right arrow only.
- c. Both right and left arrow simultaneously.
- d. Caution flashing of four or more lamps in a pattern which does not indicate a direction.

7. Each arrow panel lamp shall have a minimum visible diameter of 100 mm.

8. A small lamp, flashing in sequence with the warning indication, shall be located on the back of the arrow panel. This light should be visible to personnel in the protected work area. If it is not operating, they will know the flashing arrow also has stopped operating.

9. Controls shall be provided which are capable of dimming the lamps by reducing lamp voltage through a range of from 100

percent to a minimum of 50 percent of the rated lamp voltage. The flashing or sequencing rate of lamps shall not be less than 30 nor more than 45 complete cycles per minute.

10. Arrow panels are normally mounted on a trailer or truck but another suitable support may be used. Panels should be mounted with the bottom of the panel at least 2.1 m above the roadway. Arrow panels mounted on motor vehicles should normally have controls which will allow changing modes of indication from the driver's position.

#### **D. Floodlights**

1. Floodlights (or standard highway lighting luminaires) have infrequent but important uses in both construction and maintenance work areas. When floodlights or highway luminaires are used, care should be taken to light the work area without putting glaring light into the eyes of drivers. The

adequacy and safety of the lighting can best be checked and adjusted by driving through the area at night.

2. On construction projects, lighting is most frequently warranted at flagman stations when work is done at night or at abrupt changes in alignment and similar high hazard areas. The lighting should be a supplement to, not a substitute for proper signs, barricades, delineation, and other devices.

3. Maintenance activities on heavily traveled urban expressways must often be done at night when traffic volume is lowest. Good lighting of the work site aids the workmen and assists drivers in seeing the equipment, workmen, and work areas.

4. Power for lighting work areas is usually supplied by portable generators. Short-time use, frequent moves, and the lack of access to power lines normally requires on-site generation.



## 5.06 Control of Traffic Through Work Areas

### A. General

1. The primary function of traffic control procedures is to move traffic quickly and safely through work areas. This is an essential part of highway construction and maintenance operations. Since the conditions and requirements of work sites may change often, traffic control measures must be frequently reviewed to assure the measures are appropriate.

2. Maintaining good public relations is necessary. Work site personnel and flaggers should be courteous to motorists. Traffic should be kept moving through the work area with as little delay as possible. The safety of work-site personnel and motorists must be a primary consideration.

### B. Hand Signaling Devices

#### 1. Flags and Warning Paddles

a. Flags, Stop/Slow paddles and traffic control signals are used in controlling traffic through work areas. Flags and paddles are the most frequently used devices for this purpose.

b. Flags for hand signaling shall be at least 600 mm square. The flags shall be made of a good grade, strong red cloth and shall be fastened to a sturdy, light-weight staff approximately 1 m in length. The free edge of the flag should be weighted so the flag will hang vertically, even in a strong wind.

c. Sign paddles shall be an octagon at least 600 mm wide with letters at least one-third the height of the paddle. The paddles shall be mounted at the top of a round, rigid handle about 2 m in length. The paddle and handle shall be fabricated from suitable light-weight durable and semi-rigid material. (See Figure 5-9.)

d. One face of the paddle shall have the STOP message in reflectorized white letters on a reflectorized red background with a reflectorized white border. The other face shall have the SLOW message in black letters and red border on a reflectorized white background.

#### 2. Flaggers

a. Flaggers are responsible for the safety of the work site crew and the motorists. They also have much contact with the public. It is necessary to select well qualified persons for this work. A flagger should meet the following qualifications:

(1) Average intelligence.

(2) Good physical condition, including sight and hearing.

(3) Mental alertness.

(4) A courteous but firm manner.

(5) Neat appearance.

(6) Sense of responsibility for the safety of the public and the crew.

b. Flaggers shall wear a red-colored safety vest, shirt or jacket, and a red-colored safety hat. If flaggers work at night, their red safety clothing shall be reflectorized.

c. Flaggers are provided at work sites

(1) to briefly stop traffic at intervals as necessitated by activities at the site, and

(2) to maintain a continuous flow of traffic past the work site at reduced speed to help protect the work crew.

d. The flagger's functions require he be clearly visible to approaching traffic. Drivers must see the flagger far enough in advance to comply with his directions and reduce speed appropriately.

#### 3. Flagger Stations

a. In rural areas, flagger stations shall be located 150 m in advance of the work site or farther if approach speed exceeds 80 km/h. In slow speed urban areas this distance may be 50 to 75 m. This will also enable the flagger to warn workmen of approaching danger, such as an out-of-control vehicle.

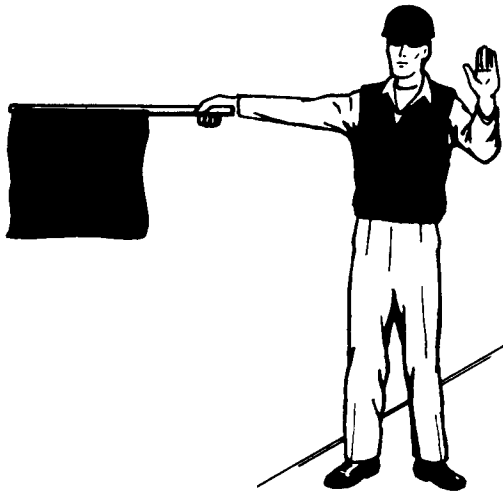
b. The flagger shall stand either on the shoulder adjacent to the lane being controlled or in a barricaded lane. At a short work area the flagger may have to stand on the shoulder opposite the obstruction. Under no circumstances may the flagger stand in a lane being used by moving traffic. The flagger shall stand alone. He shall never permit a group of workers to gather about him at the flagging station.

c. Flagger stations shall be adequately protected by standard Warning signs and flashing beacons if necessary. If flagging occurs at night, each station shall be well lighted.

#### 4. Flagging Procedures

a. The following procedures shall be followed when controlling traffic with a flag. These procedures are illustrated in Figure 5-9.

Flag

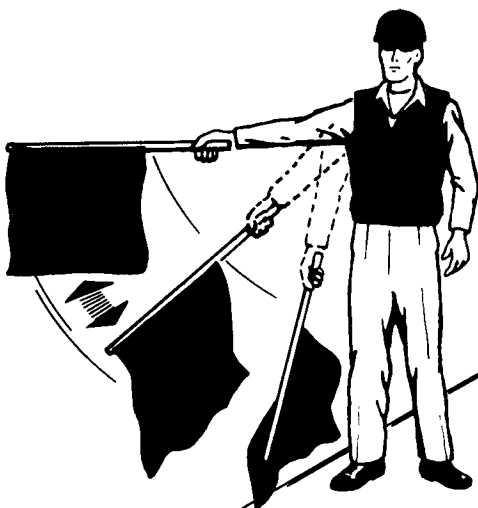
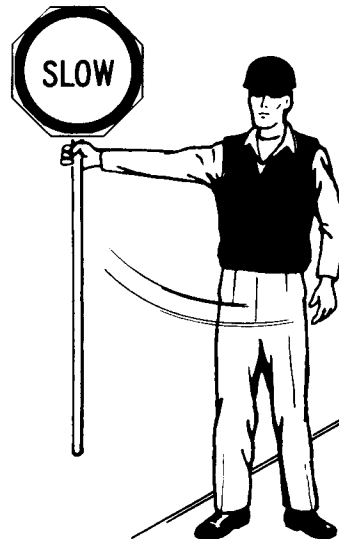


To Stop  
Traffic

Paddle



Traffic  
Proceed



To Alert  
and Slow  
Traffic

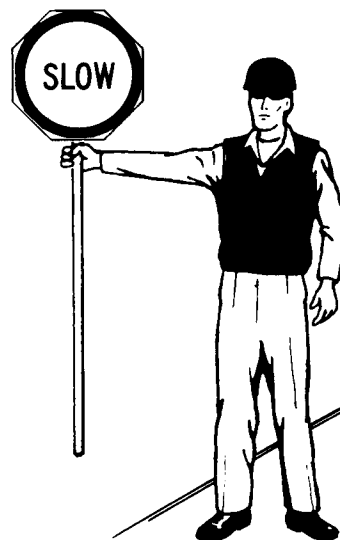


Figure 5-9  
Use of hand signaling devices by flagger

(1) To stop traffic, the flagger shall face traffic and extend the flag horizontally across the traffic lane. The flag shall be held stationary so the full area of the flag hanging below the staff is visible. For greater emphasis, the free arm may be raised with the palm toward approaching traffic.

(2) When it is safe for traffic to proceed, the flagger shall turn parallel to the traffic movement. With flag lowered from the view of the driver, the flagger shall then motion traffic ahead with his free arm. The flag shall not be used to signal traffic to proceed.

(3) When the flagger wishes to alert or slow but not to stop traffic, he shall face traffic and slowly raise and lower his arm and the flag. The flag shall be moved by a sweeping motion of the extended arm up to shoulder level and back straight down. The arm and flag should not go above shoulder level.

b. The following procedure shall be followed when controlling traffic with a paddle:

(1) To stop traffic, the flagger shall face traffic. With arm extended horizontally and the staff in a vertical position, he shall turn the STOP message toward approaching traffic. The free hand may be raised with the palm toward approaching traffic for greater emphasis.

(2) When it is safe for traffic to proceed, the flagger shall turn the SLOW message toward approaching traffic and with his free arm shall motion traffic to proceed.

(3) When the flagger wishes to alert or slow traffic, he shall stand in the same manner as when stopping traffic. Then he shall display the SLOW message to oncoming traffic.

## **C. One-Way Traffic Control**

### **1. Flagger Control**

a. When traffic from both directions must use the same lane passing a work area, provision for alternate one-way movement must usually be made. At a very short "spot" obstruction with good sight distance on a street or road with low traffic volume, one-way movements can be allowed with a minimum of traffic control.

b. When alternate one-way movements are required on a rural road section more than about 15 m in length and total traffic is greater than approximately one vehicle

per minute, additional traffic control is needed for the safety of traffic and workmen. With slow speed traffic in urban areas, flagging may not be warranted unless vehicles are considerably more numerous. Whatever traffic control is used, it must also prevent excessive delays at each end of the area. For this purpose control points (usually flagger stations) must be established at each end of the one-way section. It must be possible to communicate between those control points to coordinate the operations. Control points should be chosen to provide adequate sight distance for approaching traffic. The roadway at each control point should be wide enough to permit easy passing of opposing lines of vehicles.

c. Alternate one-way movement of traffic between control points can be accomplished in several ways, one of which is by flaggers. Where the one-way section is short, and the flaggers can see each other, traffic can be controlled by a flagger at each end of the section. One flagger should be designated as the chief flagger and is responsible for coordinating the flagging operations. The flaggers shall be able to communicate with each other verbally or by signals which will not be mistaken as a signal to traffic. One flagger may be sufficient for very short lane closures where adequate sight distance is available for safe handling of traffic by the flagger.

d. Where one end of a short one-lane section is not visible from the other end, the flaggers can maintain contact by radio. One flagger tells the other flagger the license number or other identification of the last vehicle which he allows to enter the one-way section. When that vehicle reaches the second flagger, he knows he can release a group of cars into the one-way section from his end.

### **2. Flag-Carrying Car**

a. The use of a flag-carrying car is effective where the one-way section is well defined, not hazardous and of moderate length, usually 1.5 km or less. It is effective over a longer section than flagger control.

b. In this type of one-way traffic control, the driver of the last vehicle entering the section from one end is given a red flag or other token. He is instructed to deliver it to the flagger at the other end of the section. When the driver delivers the flag to him, the flagger knows it is safe to allow

traffic from his end to move into the section. The last driver to enter from his end carries the flag back to the other end. The flag being carried from one end to the other should always be clean and dry.

c. A variation of this procedure is to use an "official" vehicle which always follows the last vehicle entering the section. This eliminates use of a flag and its possible loss, but requires an additional man and vehicle.

### 3. Pilot Car

a. A pilot car can be used to guide a group of vehicles through a work area or detour. It is especially effective when the route is relatively long, hazardous, complicated or frequently changed. The operation of the pilot car must be coordinated with the flaggers at each end of the section, as in the case of the flag-carrying car.

b. Sufficient room must be provided for the pilot car to turn around at each end of the section. The driver of the last vehicle in the group following the pilot car should be given a small red flag to hand to the flagger at the other end of the section.

c. The pilot car should be light weight and easy to handle. The name of the contractor or contracting authority shall be prominently displayed on the vehicle. The pilot car sign shall be visible from the rear of the vehicle. A flashing yellow beacon may be mounted on the top of a pilot car for additional identification.

d. Two or more pilot cars may be needed to guide two-way traffic through a complex or hazardous detour.

### 4. Traffic Control Signals

a. Traffic control signals are a satisfactory and economical means for control of traffic movements at construction or major maintenance work areas:

(1) Control of a highway or street intersection with a temporary "haul road" or equipment crossing.

(2) Control of traffic at the intersection of a detour with another street or highway.

(3) Control of traffic through a one-lane, two-way section of highway.

b. To provide alternative one-way movements on a one-lane section requires the following traffic control signal operation:

(1) A GREEN ROUND signal indication to allow traffic to enter the section from one direction, and a simultaneous

RED ROUND signal indication to prevent traffic from entering at the other end. The green interval should be long enough to allow most waiting vehicles to enter and is usually extendable by vehicle-detectors placed adjacent to or under the pavement.

(2) A short (4-5 seconds) YELLOW ROUND change interval shall follow the green interval.

(3) A RED ROUND clearance indication shall follow the yellow interval. The red indication shall be shown simultaneously at both ends of the section. This red interval shall be long enough to allow vehicles which have entered on the green indication to drive the length of the section.

(4) Upon completion of the all red clearance interval described in paragraph (3), the green indication is displayed to the opposing vehicles that had been waiting on the opposite approach.

(5) In the absence of traffic on either approach, the signal shall continue to display a GREEN ROUND signal indication to the approach on which a detector was last actuated.

c. Traffic-actuated signal control of a one-lane section, as described in paragraph b, requires a vehicle detector at each end of the section. Each detector must be located where approaching vehicles will activate it before reaching the stop line. Signal heads and indications (and also detectors in the case of traffic-actuated signals) at both ends of the one-way section must be connected to the same controller or, if two controllers are used, the signals must be interconnected physically or electronically. Pretimed control is used for one-way sections where it is difficult to obtain accurate detector actuation at both ends of the section.

d. The length of the yellow and all red signal intervals are fixed, but the length of the green intervals is timed by the controller in accordance with traffic demand.

e. All traffic signal and control equipment used in construction and maintenance areas, and the installation and operation, shall meet the requirements of Part 4 of this Manual.

f. Traffic-actuated control should usually be installed at intersections with other highways or equipment crossings. It is usually more efficient than manual or pre-timed control.

## **D. Work Areas on Expressways, Multi-lane Arterials and Collectors, and Other High-Volume Highways**

### **1. Special Problems**

a. The general principles of safety, minimum delay, positive guidance, frequent inspection and adjustment of equipment, and procedures apply to traffic control in work areas on all types of highway facilities. The speed and volume of traffic on expressways and other high-volume highways, which have little seasonal variation result in special and serious problems. The best available warning and regulatory devices are needed. Most important is the preparation of a complete traffic control plan for every stage of the project.

b. Problems and problem areas include the following:

- (1) Lane closures.
- (2) Median barriers that make total roadway closure difficult.
- (3) Temporary merging and exit areas at interchanges and crossings.
- (4) Nighttime work areas.
- (5) Lack of alternate routes for detouring traffic from the work area.
- (6) The requirement that traffic flow be maintained.

### **2. Signing**

a. Enlarged Warning signs with standard messages which are familiar to motorists are desirable on expressways and other high-volume highways. Warning signs larger than 1100 mm will often be needed. Flashing Warning Arrow Panels, Hazard Identification Beacons and lighting are especially applicable on these highways.

b. Where vehicles are unusually fast or numerous, warning of the work area shall be given 2 km in advance of the work site. The warning should be repeated at 1 km from the site. Where unusually long delays may occur at the work site, traffic should be given notice of these delays in advance of exits to one or more alternative routes.

c. A complete series of Warning signs shall be placed on both sides of the roadway. The signing shall give specific information (for example, which lane is closed). Suggested safe speed signs may be used and shall not show a speed lower than what is practicable considering the curvature and sight distance. Speed limit signs may be used in work areas to notify of

legal speed limits. Those speed limit signs that do not apply during construction or maintenance operations shall be temporarily covered or removed.

d. Special signing, for example, to confine heavy vehicles to a specified lane or lanes, may be needed and should be large. Such regulatory signing shall be repeated at appropriate intervals, particularly beyond entrances to the facility from another highway.

e. Signing and delineation for existing exits and entrances must be carefully planned where lane closures will change established geometrics. Existing signing may have to be revised or relocated temporarily to be visible and effective.

f. All supports for signs shall be break-away or shall have an impact cushioning device to protect motorists. The design of the breakaway supports and the installation of the crash cushion shall be approved in advance by the Ministry of Communications (MOC). Existing Regulatory, Warning, and Informative signing not suitable during the period of construction or maintenance shall be removed or covered so the message is not visible.

g. A sign shall always be placed at the end of a work area to tell motorists they are leaving the area of special control.

h. Signs warning of conditions that no longer exist shall be promptly removed.

### **3. Channelization**

a. One of the most critical places in work area traffic control is where traffic from a closed lane merges with traffic in adjacent lanes. Despite Advance Warning signs, most drivers do not begin the merging movement until they approach the taper where lane closure begins. Thus, the taper length must be great enough to give drivers sufficient distance to find a gap in traffic large enough for them to merge into the adjacent lane. If vehicles in the closed lane stop or slow to a speed much less than traffic in the adjacent lane, accidents are almost certain to occur.

b. The minimum taper length that may be used in lane closures is shown in Table 5-1. A taper length greater than the minimum will often be operationally better. The taper length should also be increased as required by the site conditions.

c. Standard devices such as barricades, barrels, drums, and cones may be used for

transition sections. However, temporary redirecting concrete barrier sections may be the best and most economical device for the purpose and are re-usable. These barrier sections are especially effective and desirable where a great hazard would occur to any vehicle which left the roadway. In addition, illumination may be necessary if it is not already present.

#### **4. Pavement Marking**

a. Pavement marking is a valuable tool to supplement signing on an expressway or other high volume highway in a work area. Temporary reflecting pavement marking materials shall be used to delineate the traffic path, and shall be removed promptly when the path of traffic is changed. Normal pavement markings that conflict with temporary vehicle paths shall be removed.

b. Reflective raised pavement markers shall be used as follows to supplement the pavement marking on traffic diversions and detours:

(1) On the center line of all two-lane, two-way diversions which carry more than 1000 vehicles per day and will be used for 1 month or more.

(2) On the center line and edge lines of all two-lane, two-way diversions which will carry more than 5,000 vehicles per day for more than 1 week.

(3) On the center line, lane lines, and edge lines of all four-lane, two-way diversions. It is assumed traffic volume is heavy enough to warrant two lanes in each direction.

(4) On detours of major highways where unusual hazard or traffic volume is especially great.

c. Reflective tubular markers shall be used rather than raised pavement markers on two-lane, two-way diversions of expressways and other high volume highways which carry 5,000 or more vehicles per day.

d. Because work on urban expressways will frequently be done at night, illumination of work areas should be seriously considered. Battery-operated flashing warning lights shall be placed on Warning signs and steady burning lights shall be used on delineation devices.

#### **5. Traffic Control Requirements**

a. During maintenance and reconstruction of expressways and other high volume facilities, as many lanes as possible shall be kept open to traffic at all times. This will allow traffic to flow with the least interference and delay. Traffic control signals shall not be used to stop expressway traffic.

b. Participation of enforcement authorities in the planning for traffic control during work on expressways and other high volume highways is highly desirable. Additional police may be needed to assist in keeping traffic flowing. An emergency traffic operation plan should be developed for alternate routing of traffic if unacceptable congestion develops.

c. Personnel responsible for construction and maintenance work on expressways should have formal training in traffic control on those facilities. They should recognize the importance of keeping traffic moving safely and smoothly through those areas.

## 5.07 Selection and Use of Traffic Control Devices

A. Traffic control devices for construction, maintenance, and utility work zones include signs, channelizing devices, temporary pavement markings, hand signaling signs or flags, lighting units, arrow panels, and high level danger warning devices.

B. The following items should be considered when selecting work area signing:

1. Select signs that appropriately and accurately describe the work area situation.
2. Select the message according to the action the driver is required to make.
3. Place a Warning sign in advance of and at the beginning of the work area. As drivers approach the work area, other signs with increasingly more specific messages will be necessary.
4. The overall effect of the sign series and the attendant supporting devices should be evaluated. This is to insure that the driver is aware of the condition being approached and his resultant action is appropriate.

C. Each situation requires varying the application of the devices to fit, but some basic requirements relate to most conditions:

1. The flaggers shall be in sight of each other, or in direct communication, at all times.
2. Operations restricting vehicular movement, so traffic in both directions must use a single lane, shall only be allowed while flaggers are on duty or when a temporary traffic signal is installed to assign right-of-way.
3. Steady burning lights used on Type I or Type II barricades will not be required for day operations.
4. A minimum of two flashing lights shall be used at night on each approach in advance of the work area. Flashing lights shall be installed above at least the first sign in the series.
5. Longitudinal dimensions may be adjusted slightly to fit field conditions.
6. All signs shall be post mounted if the closure time exceeds 7 days.
7. When a side road intersects the highway where work is being performed, additional traffic control devices shall be erected as directed by the Engineer.
8. The Engineer may require plastic drums to be used to supplement the barricades if the closure time is of a longer term activity period over and above maintenance or utility work.

9. Cones may be substituted for barricades during day operations.

10. All taper lengths are in accordance with Table 5-1.

11. At the completion of the day's operations all temporary signs pertinent to the operation shall be removed or fully covered to not be visible.

12. Type I or Type II barricades used for delineation at night shall be equipped with steady burning lights.

13. Road work signs are removed when no work is being performed. Any unattended obstacle or excavation in the work area shall be protected with Type I or Type II barricades with flashing lights.

14. Cones have a greater visibility than do tubular markers, but are not as visible as barricades, drums, or panels. For this reason, they should only be used where the speed of traffic is low or moderate, and for temporary installations of a few hours at most (See Section 5.03 B).

15. Drums are most commonly used to channelize or delineate traffic flow but may also be used singly or in groups to mark specific hazards (See Section 5.03 D).

16. Type I barricades are intended for use where traffic is maintained through a work area. Type I barricades may be used singly or in groups to warn of a specific hazard or in a series for channelizing traffic. Type I barricades are normally used where sufficient lateral space is available. Type II barricades are intended for road closures (See Section 5.03 E).

17. High level warning devices, consisting of several red flags on a tall support, are used to supplement other devices to warn of work areas or obstructions in the roadway. These devices are most commonly used in urban, high density traffic where short-time work such as pavement patching, surveying or utility installation, and repair is being done. (See Section 5.03 G).

18. Delineators may be used to show the roadway alignment on highway sections in work areas or on detours. Barricades or other channelizing devices shall be used where more than the usual hazard exists. (See Section 5.04 C).

19. Flashing Warning Arrow Panels are useful devices to supplement Warning signs where traffic volumes and speeds are high (See Section 5.05 C).

20. Portable redirecting concrete barrier sections may be the best and most economical device for channelizing traffic in a lane transition or merging area and are re-usable.

These barrier sections are especially effective and desirable where a great hazard could occur to any vehicle which left the roadway (See Sections 5.03 F and 5.06 D3).

## 5.08 Typical Methods of Traffic Control Through Work Areas

Typical traffic control methods applied to varying conditions of need through work areas are illustrated in the following examples. Accompanying these illustrations are special notes (if

not covered in the general notes) which explain the application of these methods and the traffic control devices used.

### Examples

Case I-A: Where Work is Clear of Roadway at Least 5.0 m from the Edge of Pavement

Case I-B: Where Work is Clear of Roadway at least 5.0 m from the Edge of Pavement (Expressway)

Case I-C: Where Work is Clear of Roadway and within 5.0 m of the Edge of Pavement

Case I-D: Where Work is Clear of Roadway and within 5.0 m of the Edge of Pavement (Expressway)

Case II: Encroachment in One Lane  
**Two Lane, Two-Way Operation**

Case III-A: Intermittent or Continuous Moving Operations in Close Proximity to the Pavement or Shoulder

Case III-B: Intermittent or Continuous Moving Operation on the Pavement or Shoulder

Case IV-A: Short-Time Operations with Some Work on the Pavement

Case IV-B: Short-Time Operations in Close Proximity to the Pavement or Shoulder

Case V: Activities Encroaching on One Lane of a Bridge Deck and When Traffic Signals are Required

Case VI: Closure of Both Lanes and Use of a Temporary Detour

Case VII-A and B: Encroachment on Pavement During Pavement Widening Procedures

Case VIII: When Activities Encroach on Any Portion of the Lane Immediately Adjacent to the Shoulder Within 0.5 m of the Edge of the Pavement

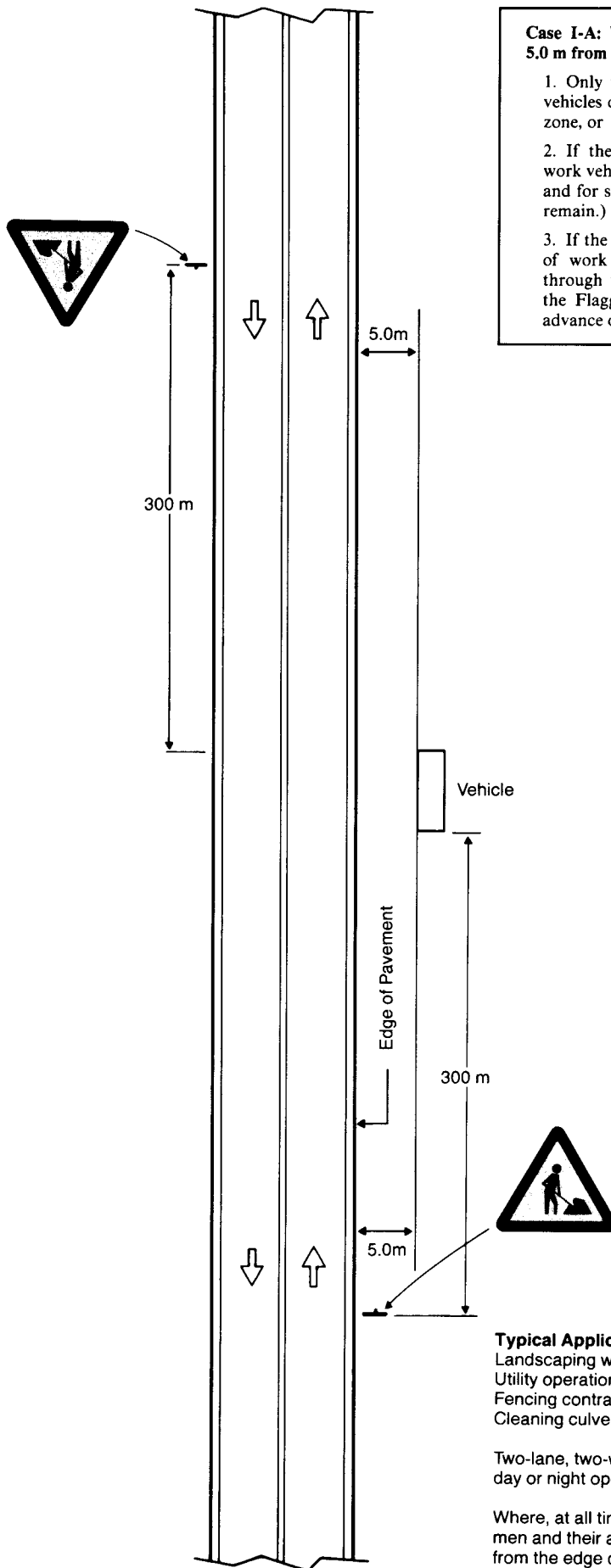
Case IX: When Activities Require the Closure of Two Adjacent Lanes and a Temporary Crossover Is Provided by Making Use of One Lane Normally Used by Opposing Traffic

Case X: When Activities Require the Closure of Two Adjacent Lanes and a Temporary Detour Is Provided By Making Use of One Lane Normally Used By Opposing Traffic

Case XI: When Activities Require a Moving Operation When the Average Speed of Movement Is Greater Than 2 km/h But Less Than 20 km/h

Case XII: When Activities Encroach on the Pavement, Requiring Closure of One Traffic Lane in an Area Where Speeds Are in a Lower Range Posted Area

Case XIII-A and B: When Activities Encroach on the Pavement, Requiring the Closure of at Least One Traffic Lane in an Area Where the Posted Speed Is 60 km/h or Less



**Case I-A: Where Work is Clear of Roadway at Least 5.0 m from the Edge of Pavement**

1. Only the ROAD WORK Sign is required if work vehicles or workmen do not encroach on the 5 m clear zone, or
2. If the work operation requires small number of work vehicles to cross the 5 m clear zone intermittently and for short periods. (The ROAD WORK Sign shall remain.)
3. If the work operation requires that a small number of work vehicles frequently enter and occupy the through traffic lanes, a flagger shall be provided and the Flagger Ahead sign shall be installed 300 m in advance of the flagger.

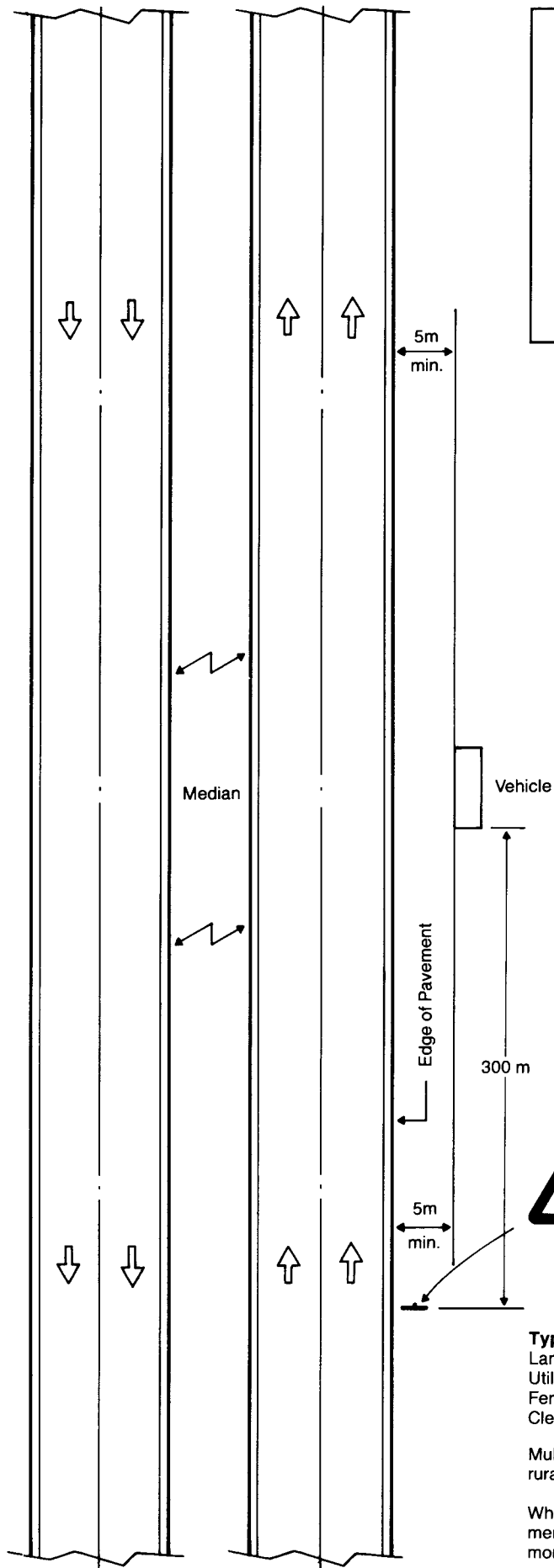
**Typical Applications**

Landscaping work  
Utility operations  
Fencing contracts and maintenance  
Cleaning culverts

Two-lane, two-way traffic, rural  
day or night operations.

Where, at all times, all vehicles, equipment, men and their activities are more than 5.0m from the edge of pavement.

**Case I-A**



**Case I-B: Where Work is Clear of Roadway at Least 5.0 m from the Edge of Pavement (Expressway)**

1. Only the ROAD WORK Sign is required if work vehicles or workmen do not encroach on the 5 m clear zone, or
2. If the work operation requires small number of work vehicles to cross the 5 m clear zone intermittently and for short periods. (The ROAD WORK Sign shall remain.)
3. If the work operation requires that a small number of work vehicles frequently enter and occupy the through traffic lanes, a flagger shall be provided and the Flagger Ahead sign shall be installed 300 m in advance of the flagger.



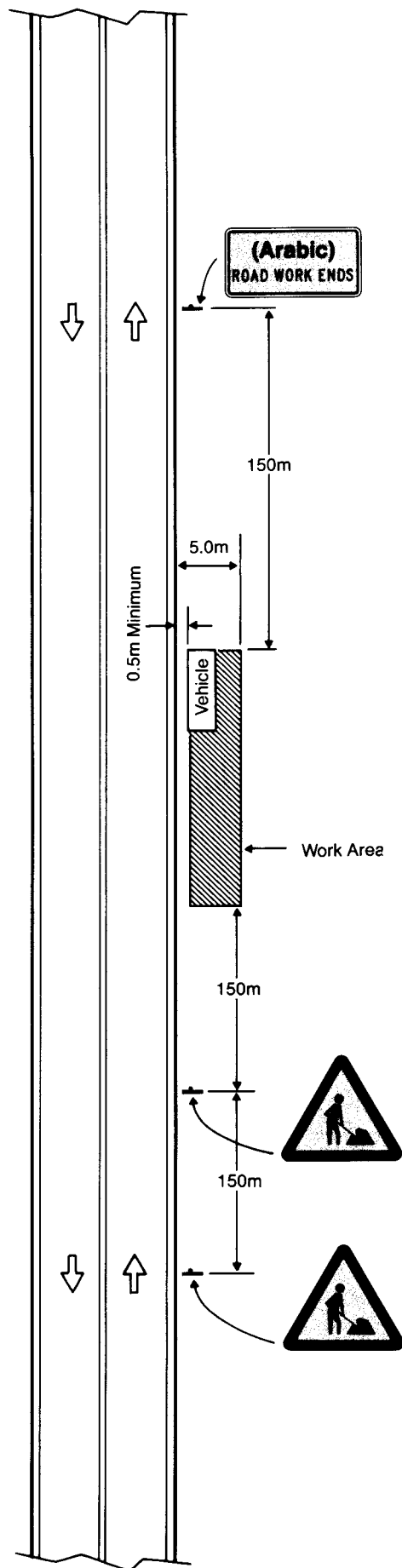
**Typical Applications**

Landscape work  
Utility work  
Fencing contracts and maintenance  
Cleaning culverts

Multi-lane, divided and undivided  
rural day or night operations

Where, at all times, all vehicles, equipment, men or their activities are at all times more than 5m from the edge of the pavement

**Case I-B**



**Case I-C: Where Work is Clear of Roadway and within 5.0 m of the Edge of Pavement**

1. The signing is required if work vehicles or workmen encroach on the 5 m clear zone, or
2. If the work operation requires small number of work vehicles to cross the 5 m clear zone intermittently and for short periods.
3. If the work operation requires that a small number of work vehicles frequently enter and occupy the through traffic lanes, a flagger shall be provided and the Flagger Ahead sign shall be installed 300 m in advance of the flagger.
4. The same series of signs shall be installed for the opposite direction of travel.

**Typical Applications**

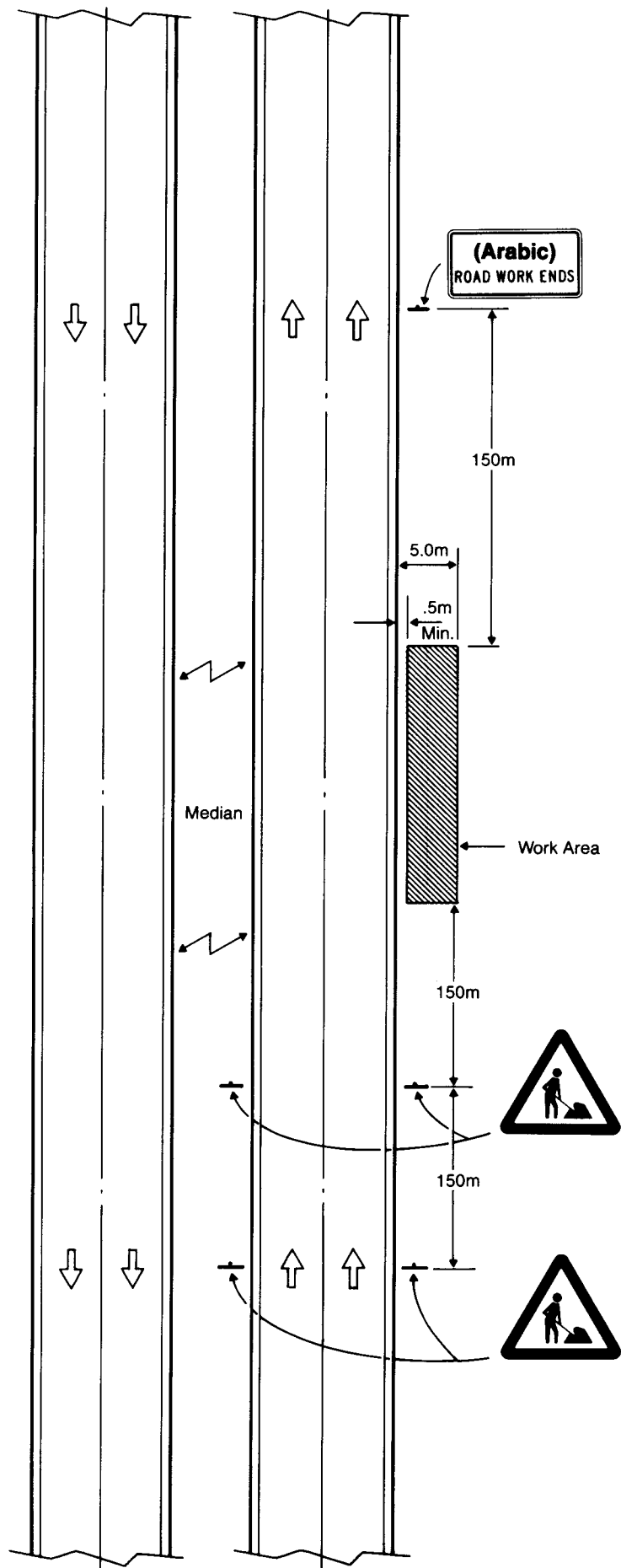
Culvert extensions  
Side slope change  
Guard rail installation and maintenance  
Delineator installation and maintenance  
Landscaping operations  
Cleaning ditches and drainage structures  
Sign installation and maintenance  
Shoulder repair

**Symbols**

— Sign on portable or permanent support

Two-lane, two-way traffic  
rural day or night operations.

Where, at any time, any vehicle, equipment, men or their activities will encroach in the area closer than 5m but not closer than 0.5m to the edge of the pavement.



**Case I-D: Where Work is Clear of Roadway and within 5.0 m of the Edge of Pavement (Expressway)**

1. The signing is required if work vehicles or workmen encroach on the 5 m clear zone, or
2. If the work operation requires small number of work vehicles to cross the 5 m clear zone intermittently and for short periods.
3. If the work operation requires that a small number of work vehicles frequently enter and occupy the through traffic lanes, a flagger shall be provided and the Flagger Ahead sign shall be installed 300 m in advance of the flagger.

**Typical Applications**

Utility operations  
Culvert extensions  
Side slope changes  
Guard rail installation and maintenance  
Delineator installation and maintenance  
Sign installation and maintenance  
Cleaning ditches and drainage structures  
Shoulder repair

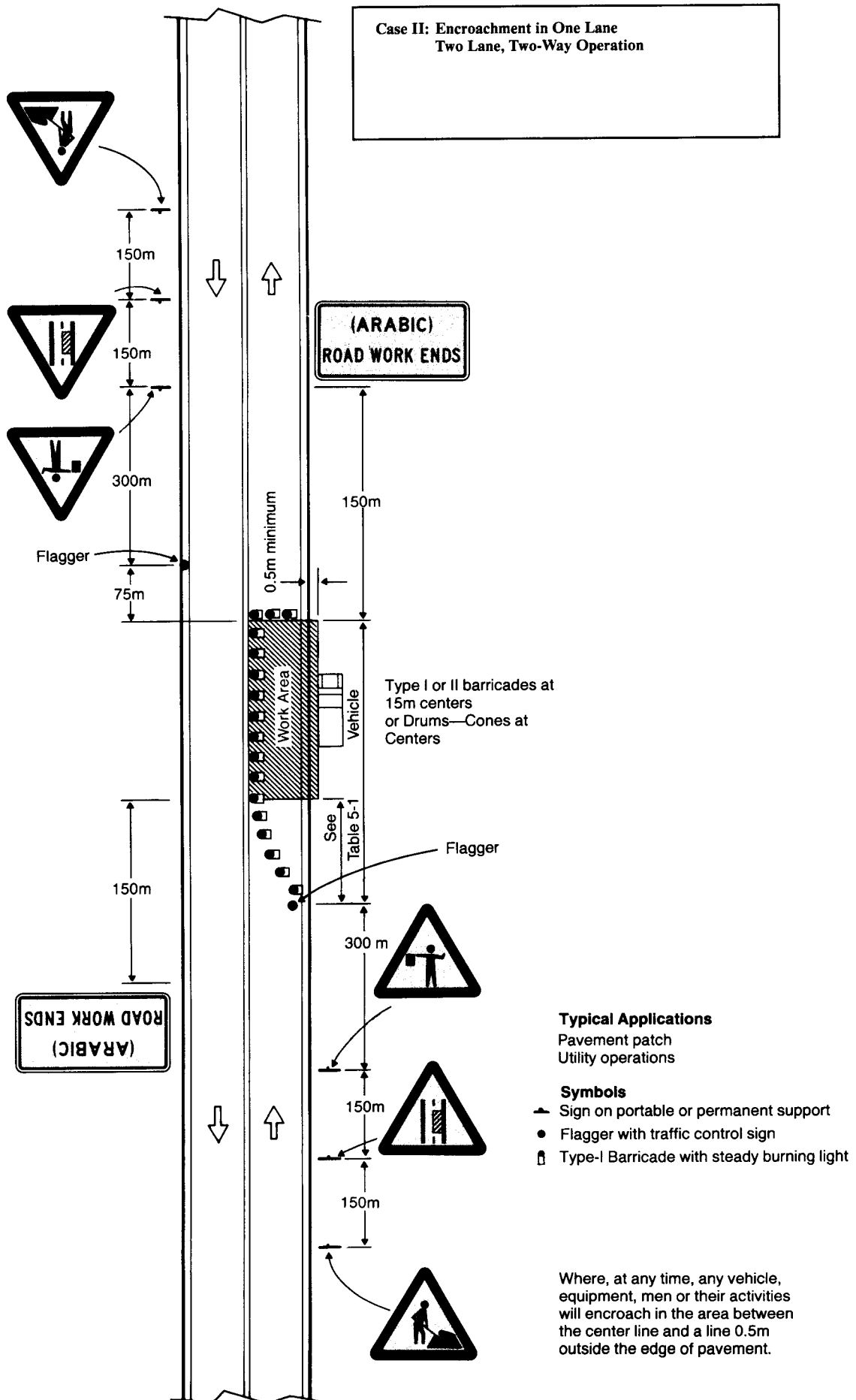
**Symbols**

Sign on portable or permanent support

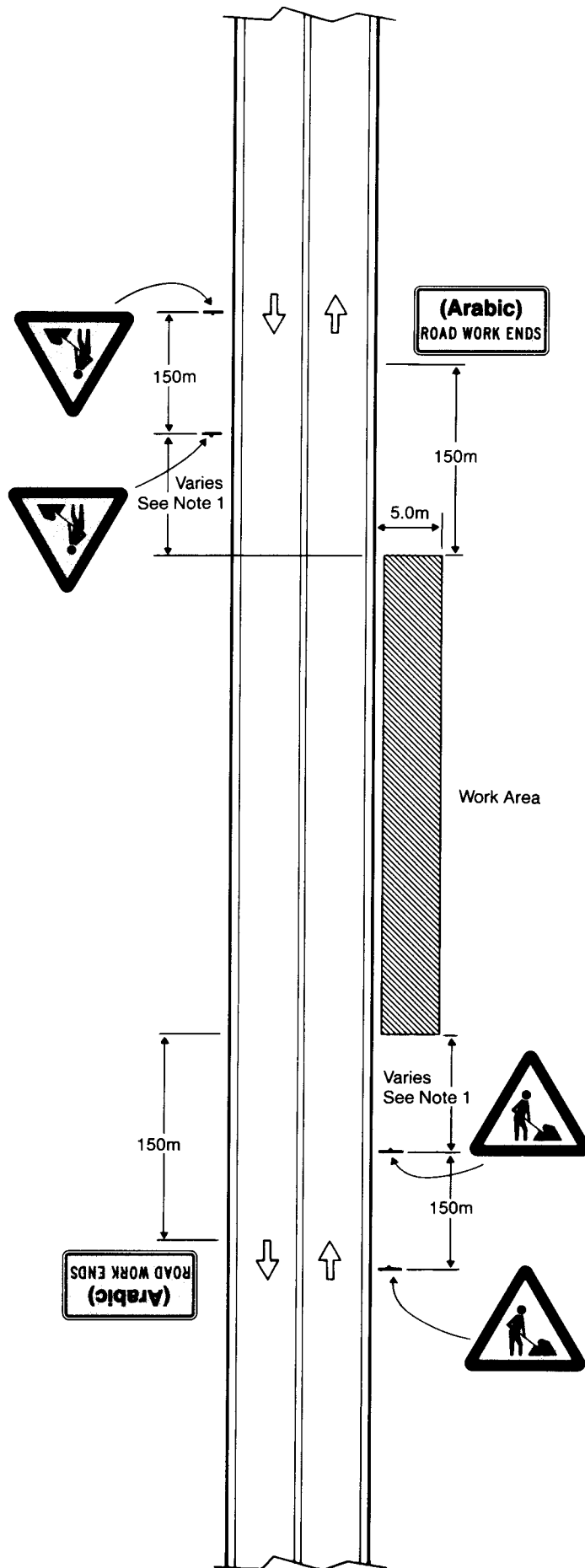
Multi-lane, divided and undivided  
rural day or night operations

Where, at any time, any vehicle, equipment, men or their activities will encroach in the area closer than 5.0m but not closer than 0.5m to the edge of pavement

**Case I-D**



**Case II**



**Case III-A: Intermittent or Continuous Moving Operations in Close Proximity to the Pavement or Shoulder**

1. The minimum length of the work site activity is 60 m. The maximum distance between the Road Works signs shall be determined by the Engineer.
2. For divided roadways, the required Advance Warning signs shall be posted on both the right and left side of the roadway.
3. If the work operation requires vehicles or workmen to enter the through traffic lanes frequently, a flagger shall be provided. The Flagger Ahead sign shall be maintained approximately 300 m ahead of the actual work area and moved with the work as necessary.
4. On roadways having four or more lanes, the Advance Warning signs for traffic using lanes which are not closed, are omitted, and Right Lane Closed Ahead sign(s) shall be installed between the first and second sign of the Advance Warning sign series. A 150 m interval shall be maintained between all signs in that series.
5. This case also applies when work is being performed in lanes adjacent to the center lane of an undivided highway having four or more lanes or adjacent to the median on a divided highway. Under these conditions, Left Lane Closed Ahead sign(s) shall be substituted for Right Lane Closed Ahead sign(s).
6. Any obstacle or excavation in the work area shall be protected by Type I or Type II barricades with flashing lights.

**Typical Applications**

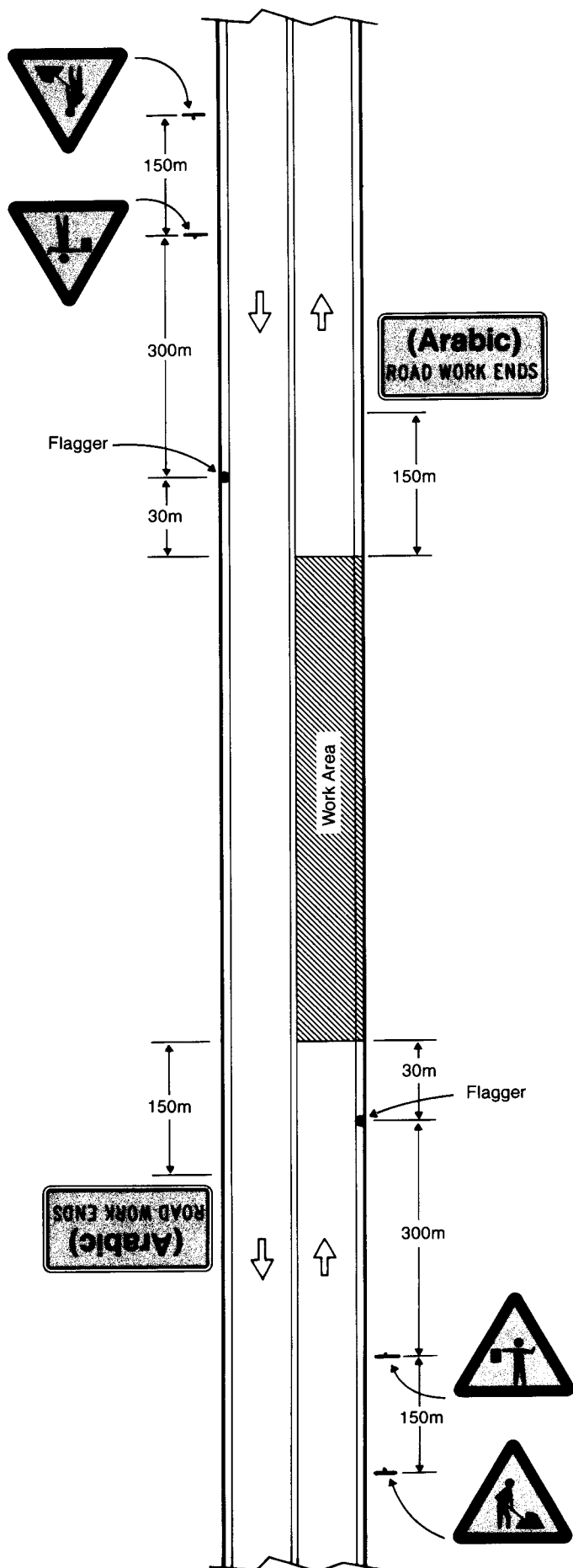
Shoulder work  
Mowing  
Utility operations

**Symbols**

→ Sign on portable or permanent support

Rural moving operations, day operation only.

Where, at any time, any vehicle, equipment, men or their activities require an intermittent or continuous moving operations on the shoulder.



#### Case III-B: Intermittent or Continuous Moving Operations on the Pavement or Shoulder

1. The minimum length of the work site activity is 60 m. The maximum distance between the Road Works signs shall be determined by the Engineer.
2. For divided roadways, the required Advance Warning signs shall be posted on both the right and left side of the roadway.
3. If the work operation requires vehicles or workmen to enter the through traffic lanes frequently, a flagger shall be provided. The Flagger Ahead sign shall be maintained approximately 300 m ahead of the actual work area and moved with the work as necessary.
4. For divided roadways, the required Advance Warning signs shall be posted on both the right and left side of the roadway.
5. On roadways having four or more lanes, the Advance Warning signs for traffic using lanes which are not closed, are omitted, and Right Lane Closed Ahead sign(s) shall be installed between the first and second sign of the Advance Warning sign series. A 150 m interval shall be maintained between all signs in that series.
6. This case also applies when work is being performed in lanes adjacent to the center lane of an undivided highway having four or more lanes or adjacent to the median on a divided highway. Under these conditions, Left Lane Closed Ahead sign(s) shall be substituted for Right Lane Closed Ahead sign(s).
7. Any obstacle or excavation in the work area shall be protected by Type I or Type II barricades with flashing lights.

#### Typical Applications

Bituminous resurfacing  
Crack pouring  
Utility operations

#### Symbols

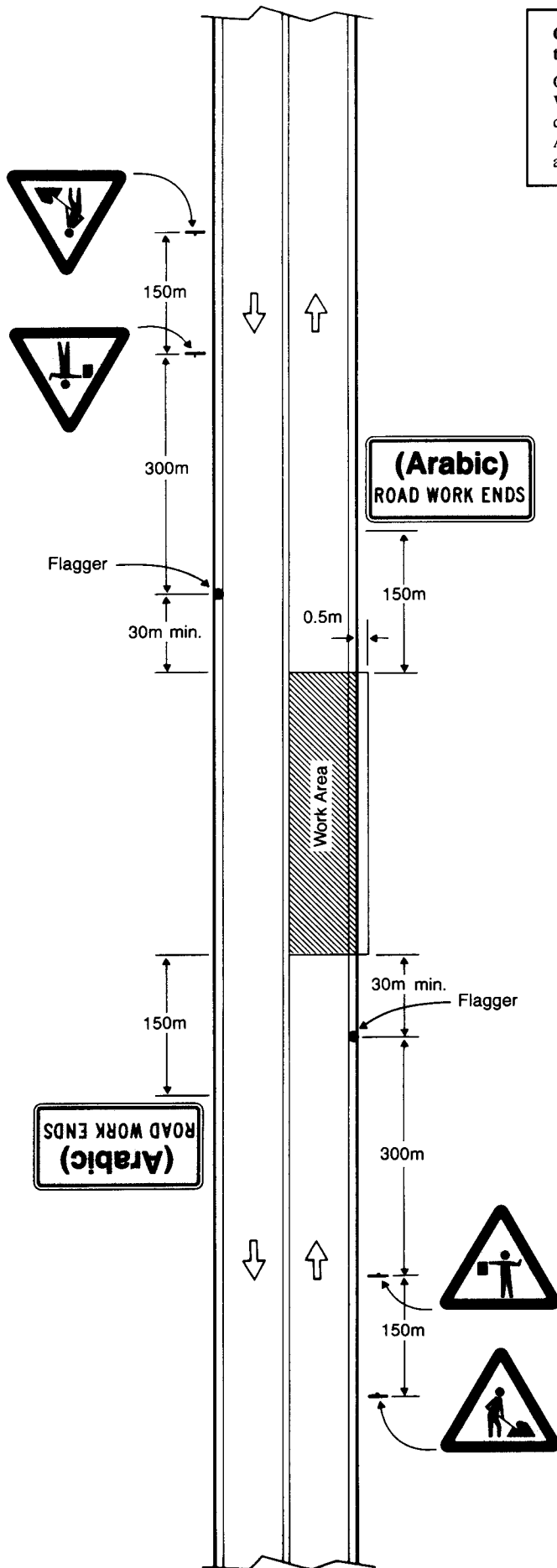
- Sign on portable or permanent support
- Flagger with traffic control sign

Rural moving operations  
Day operation only

Where, at any time, any vehicle, equipment, men or their activities require an intermittent or continuous moving operation on the pavement where the average speed of movement is less than 8 km/hr

**Case IV-A: Short-Time Operations with Some Work on the Pavement**

On roadways having four or more lanes, the Advance Warning signs for traffic approaching from the opposite direction are omitted. For divided roadways, the required Advance Warning signs shall be posted on both the right and left side of the roadway.



**Typical Applications**

Marking patches  
Field survey  
String survey  
Utility operations  
Cleaning up debris on pavement

**Symbols**

- ▲ Sign on portable or permanent support
- Flagger with traffic control sign

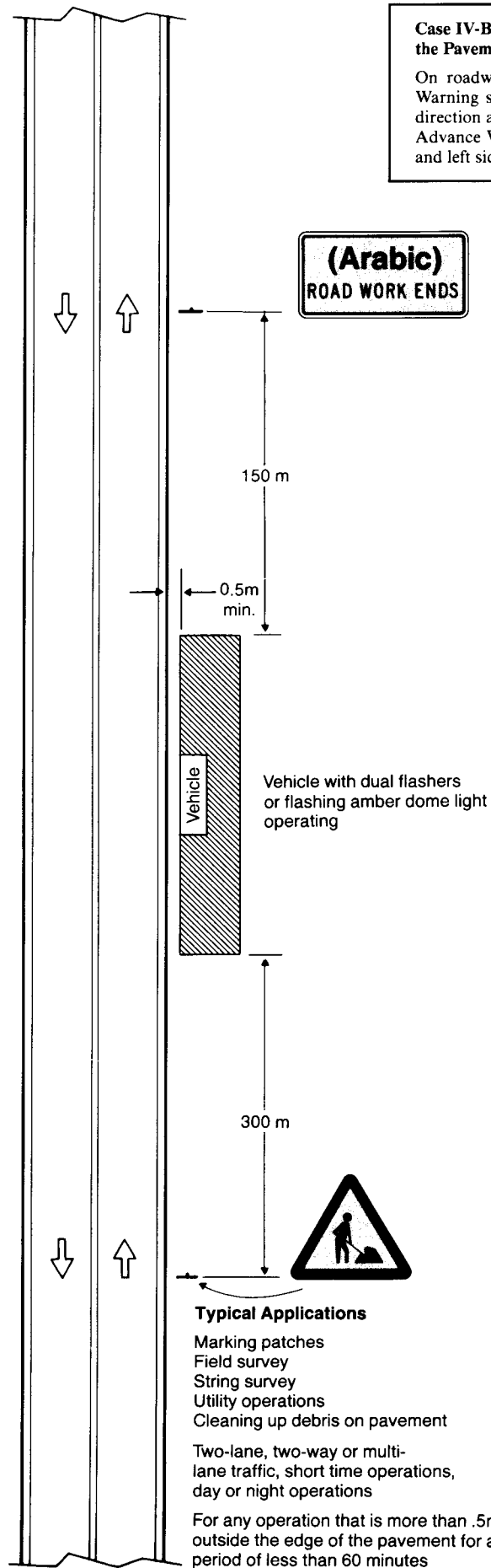
Two-lane, two-way or multi-lane traffic, short time operations, day or night operations

For any operation that encroaches in the area between the center line and a line .5m outside the edge of the pavement for a period in excess of 15 minutes but less than 60 minutes

**Case IV-A**

**Case IV-B: Short-Time Operations in Close Proximity to the Pavement or Shoulder**

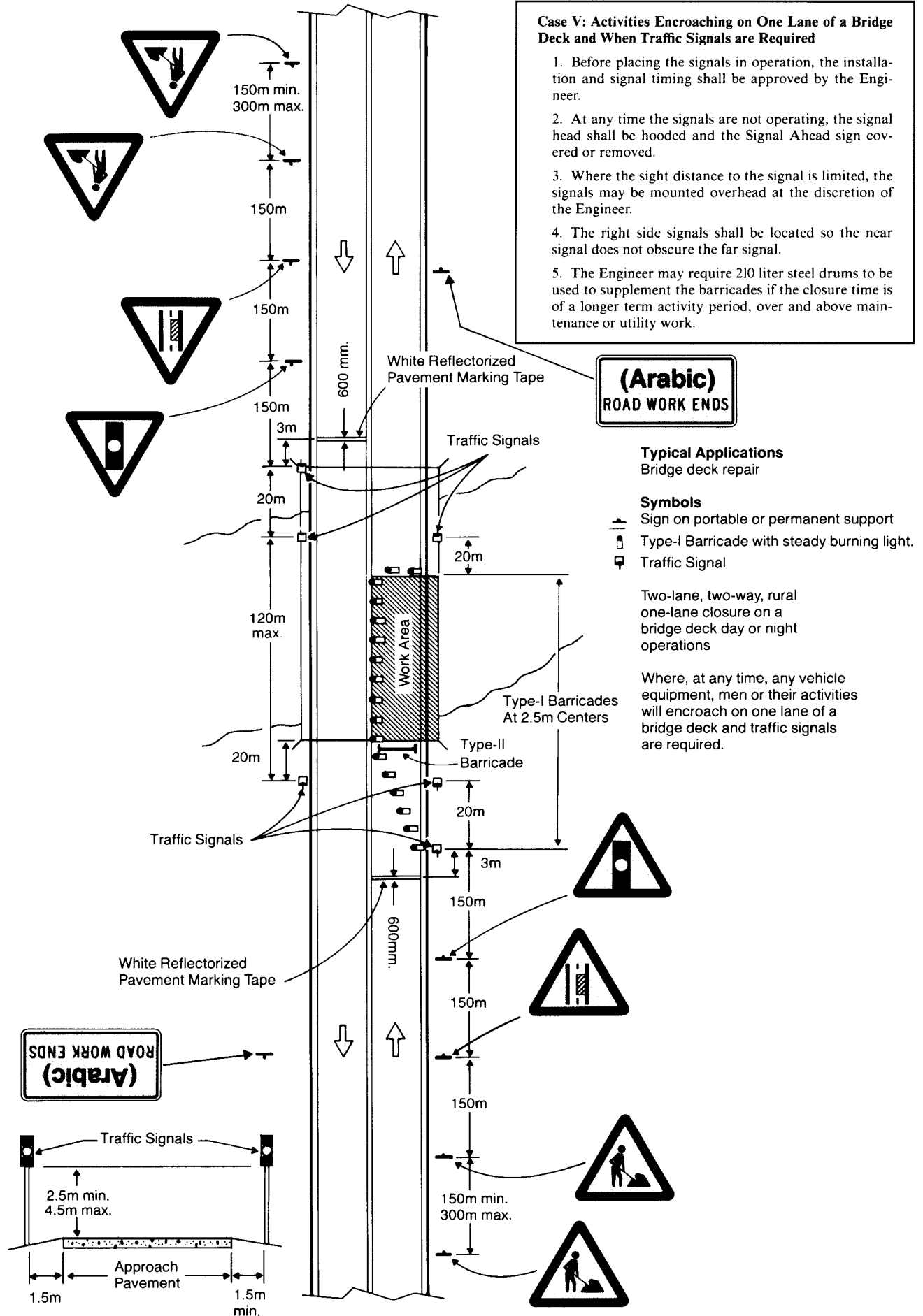
On roadways having four or more lanes, the Advance Warning signs for traffic approaching from the opposite direction are omitted. For divided roadways, the required Advance Warning signs shall be posted on both the right and left side of the roadway.



**Case IV-B**

# **Case V: Activities Encroaching on One Lane of a Bridge Deck and When Traffic Signals are Required**

1. Before placing the signals in operation, the installation and signal timing shall be approved by the Engineer.
2. At any time the signals are not operating, the signal head shall be hooded and the Signal Ahead sign covered or removed.
3. Where the sight distance to the signal is limited, the signals may be mounted overhead at the discretion of the Engineer.
4. The right side signals shall be located so the near signal does not obscure the far signal.
5. The Engineer may require 210 liter steel drums to be used to supplement the barricades if the closure time is of a longer term activity period, over and above maintenance or utility work.



**Typical Applications**  
Bridge deck repair

- Symbols**
- Sign on portable or permanent support
  - Type-I Barricade with steady burning light.
  - Traffic Signal

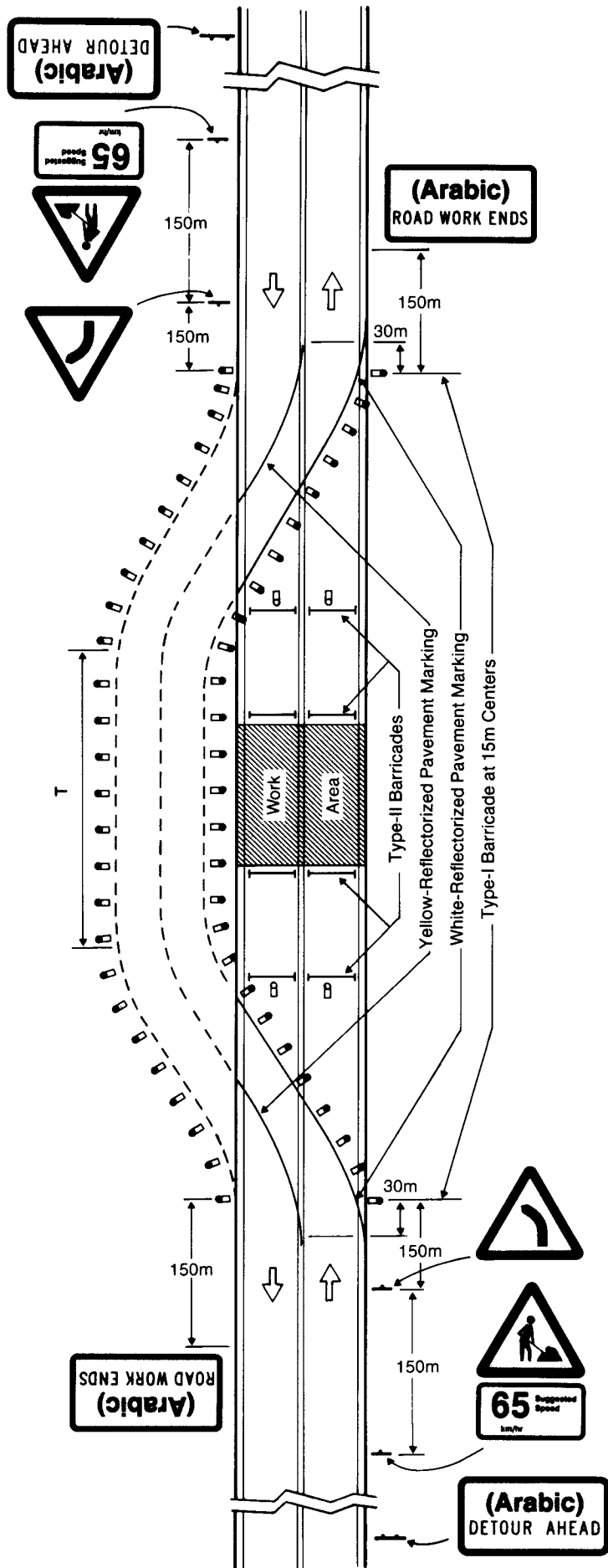
Two-lane, two-way, rural one-lane closure on a bridge deck day or night operations

Where, at any time, any vehicle equipment, men or their activities will encroach on one lane of a bridge deck and traffic signals are required.

(See Figure 4-20 for additional details)

**Case V**





#### Case VI: Closure of Both Lanes and Use of a Temporary Detour

1. Pavement markers on paved detours shall be used when the closure time is of longer duration or when the normal posted speed outside the area of operations exceeds 80 km/h. Temporary pavement marking materials shall be used for marking new center lines and edge lines on the existing pavement. All existing markings conflicting with the revised traffic pattern shall be removed. Reflectorized pavement markings shall be used on paved detours.

2. Where the tangent distance (T) on the temporary detour exceeds 180 m, spacing between barricades may be increased to 30 m within the limits of the tangent. Within these same limits, the white reflectorized marking used to indicate the center line of the traveled way may be a dashed pattern, if sight distance is adequate for passing.

3. The suggested safe speed to be shown below the Reverse Bend signs shall be determined at the site and approved by the Engineer.

#### Typical Applications

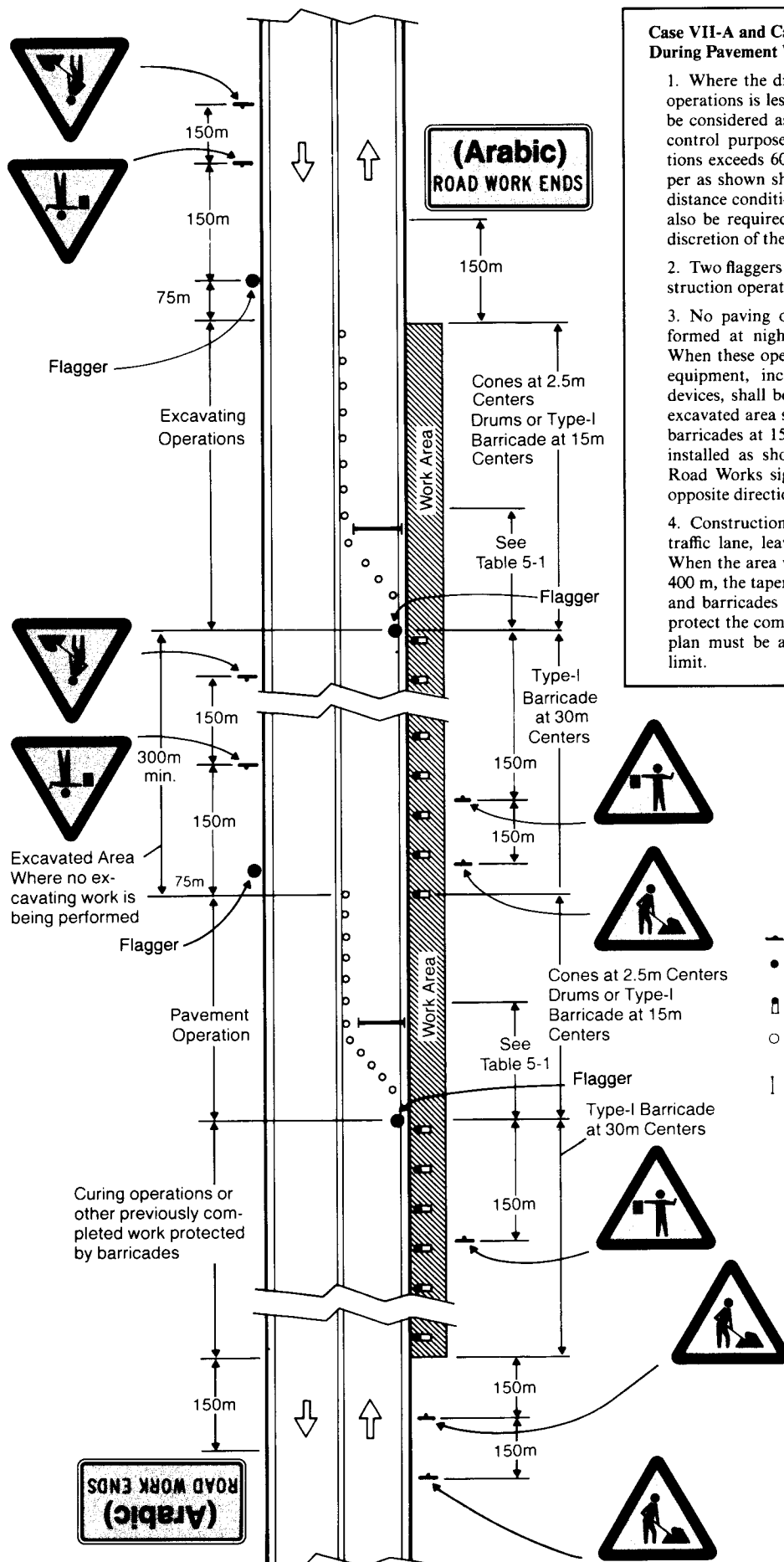
Bridge construction  
Culvert construction

#### Symbols

- Sign of portable or permanent support
- ☺ Type-I Barricade with steady burning light.
- ⚡ Type-I Barricade with flashing light.

Two-lane, two-way traffic, rural temporary runaround day or night operations.

Where, at any time, any vehicle, equipment, men or their activities require the closure of both lanes and a temporary runaround is constructed.



#### Case VII-A and Case VII-B: Encroachment on Pavement During Pavement Widening Procedures

1. Where the distance between paving and excavating operations is less than 600 m, the entire operation will be considered as one work area for signing and traffic control purposes. When the distance between operations exceeds 600 m, additional Warning signs and taper as shown shall be installed. Under restricted sight distance conditions such additional Warning signs may also be required for distances less than 600 m at the discretion of the Engineer.
2. Two flaggers shall be required for each separate construction operation within the work area.
3. No paving or excavating operations shall be performed at night unless authorized by the Engineer. When these operations are suspended, all vehicles and equipment, including traffic control and protective devices, shall be removed from the pavement and the excavated area shall be protected by Type I or Type II barricades at 15 m centers. Road Works signs shall be installed as shown to protect the curing operations. Road Works signs shall be installed for traffic in the opposite direction.
4. Construction operations shall be confined to one traffic lane, leaving the opposite lane open to traffic. When the area where work is being performed reaches 400 m, the taper and the flagman shall be moved ahead and barricades placed at the edge of the pavement to protect the completed work. A complete traffic control plan must be approved if the operation exceeds this limit.

#### Typical Applications Pavement Widening

##### Symbols

- Sign on portable or permanent support
- Flagman with traffic control sign.
- Type-I Barricade with steady burning light.
- Cone, steel drum (210 liters) or Type-I Barricades.
- | Type-I Barricades.

Two-lane, two-way traffic rural widening of pavement day or night operations

Where, at any time, any vehicle, equipment, men or their activities will encroach on the pavement during pavement widening operations.

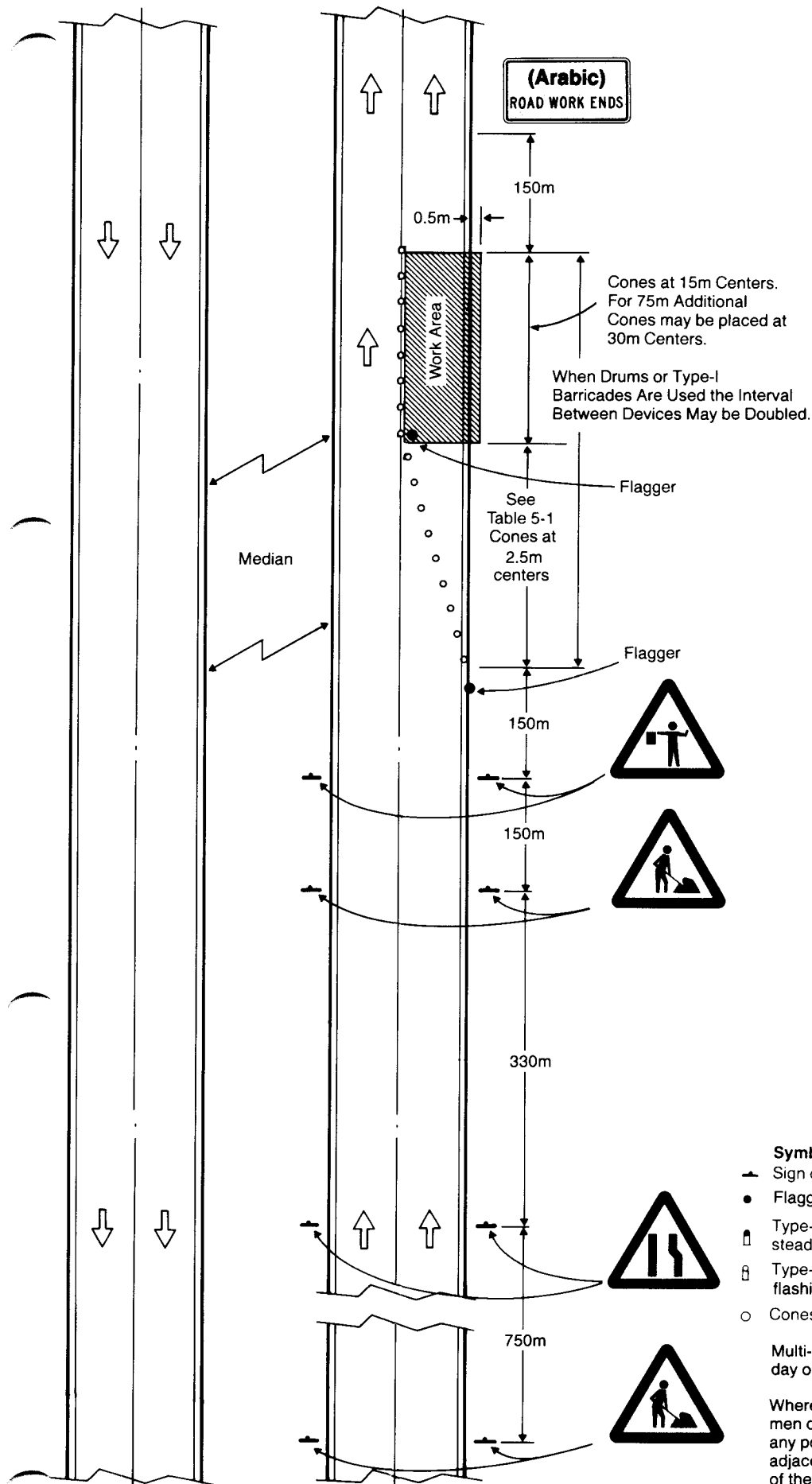


1

2

3

4



**Case VIII: When Activities Encroach on Any Portion of the Lane Immediately Adjacent to the Shoulder Within 0.5 m of the Edge of the Pavement**

1. The "L" distance equals the lane width times the taper ratio as shown in Table 5-1.
2. Operations restricting vehicular movement, so traffic in both directions must use a single lane, shall only be allowed while flaggers are on duty or when a temporary traffic signal is installed to assign right-of-way.
3. This case also applies when work is being performed in the lane adjacent to the median on a divided highway. Under these conditions Left Lane Closed signs shall be substituted for Right Lane Closed signs.
4. This case also applies when work is being performed in the lane adjacent to the center line on an undivided highway. Under these conditions Left Lane Closed Ahead sign(s) shall be substituted for Right Lane Closed Ahead sign(s). Signs shall be added in the opposite direction and cones shall be placed along the center line throughout the taper and work area.
5. This case does not apply when work is being performed in the middle lane(s) of a six or more lane highway. Special plans approved by the Engineer will be required.
6. This case also applies when work is being performed on a multi-lane undivided highway. Under these conditions the signs normally mounted in the median shall be omitted.

**Symbols**

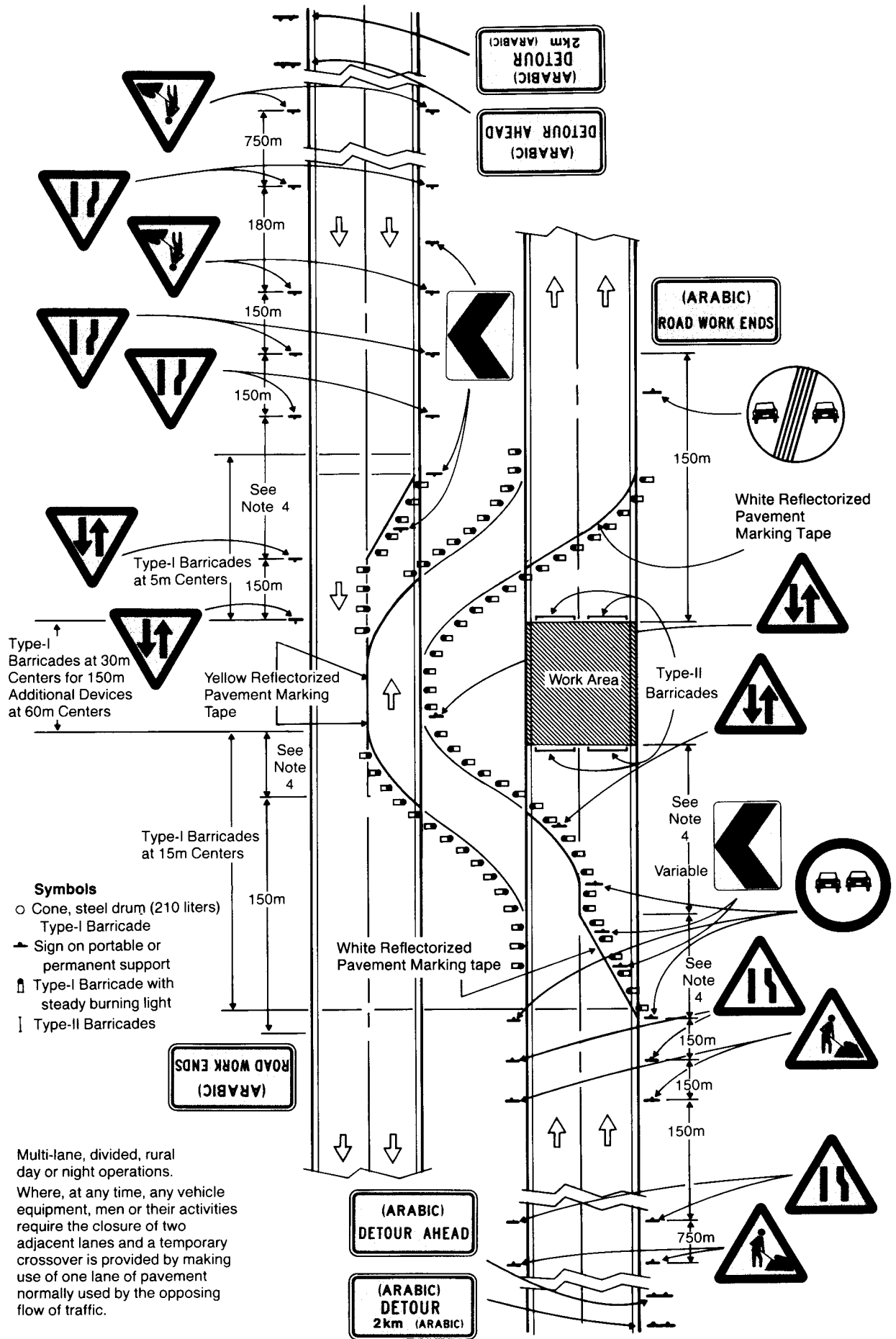
- ▲ Sign on portable or permanent support.
- Flagger with traffic control sign
- Type-I Barricade with steady burning light.
- ▣ Type-I Barricade with flashing light
- Cones

Multi-lane, divided and undivided rural day operations only.

Where, at any time, any vehicle, equipment, men or their activities will encroach on any portion of the lane immediately adjacent to the shoulder within 0.5m of the edge of pavement.

**Case IX: When Activities Require the Closure of Two Adjacent Lanes and a Temporary Crossover Is Provided by Making Use of One Lane Normally Used by Opposing Traffic**

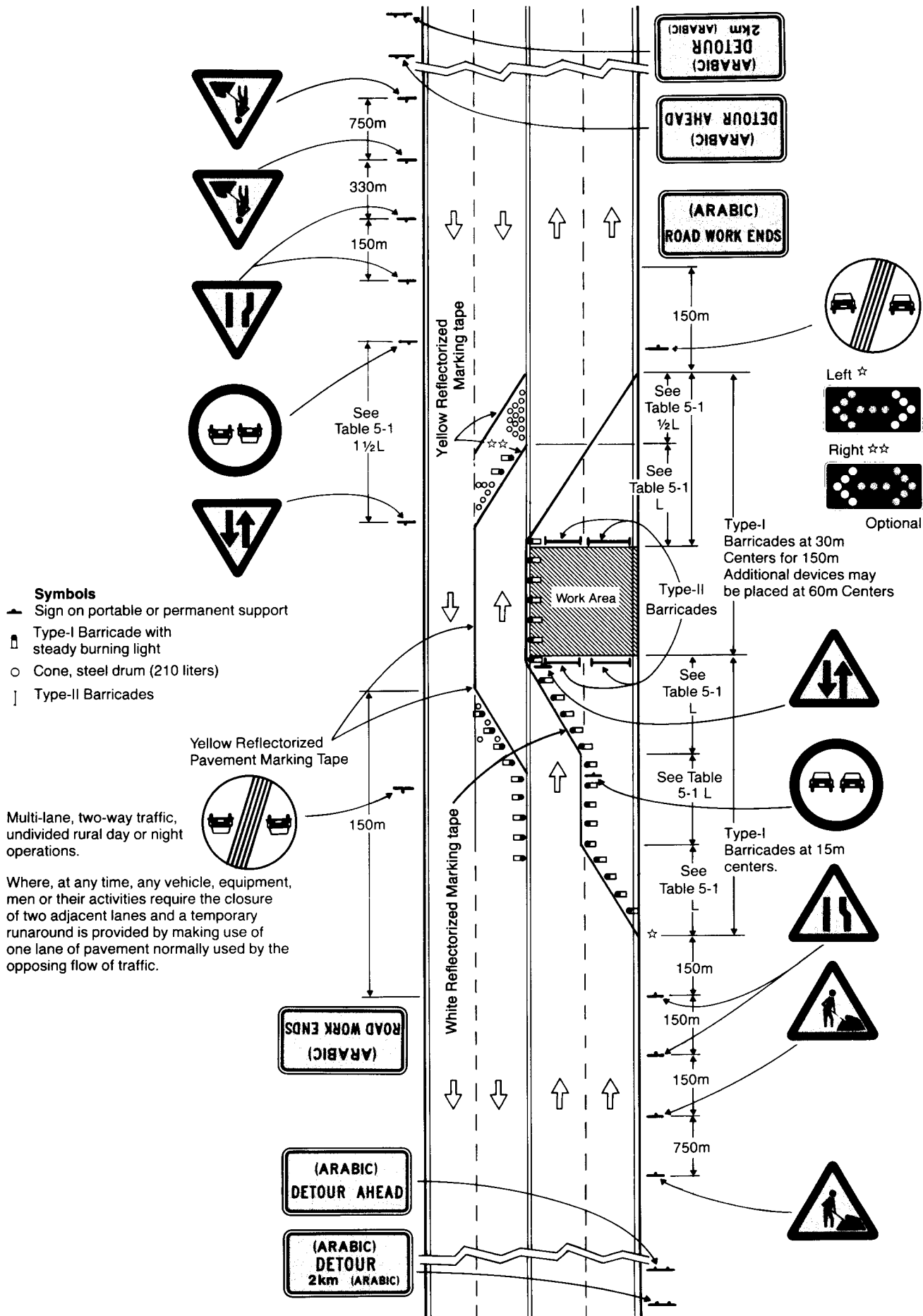
1. On paved crossovers pavement markings shall always be used. Temporary pavement marking tape shall be used for marking a new center line and edge line on the existing pavement. All existing markings conflicting with the revised traffic pattern shall be removed.
2. Two-way Traffic sign(s) shall be repeated every 400 m in each direction through the tangent distance.
3. Where the tangent distance (T) on the temporary runaround exceeds 160 m, spacing between barricades may be increased to 60 m within the limits of the tangent. Within these same limits the white reflectorized dashed marking used to indicate the center line of the traveled way may be supplemented with continuous white reflectorized markings if a no passing sight distance restriction exists.
4. The "L" distance equals the lane width times the taper ratio as shown in Table 5-1.



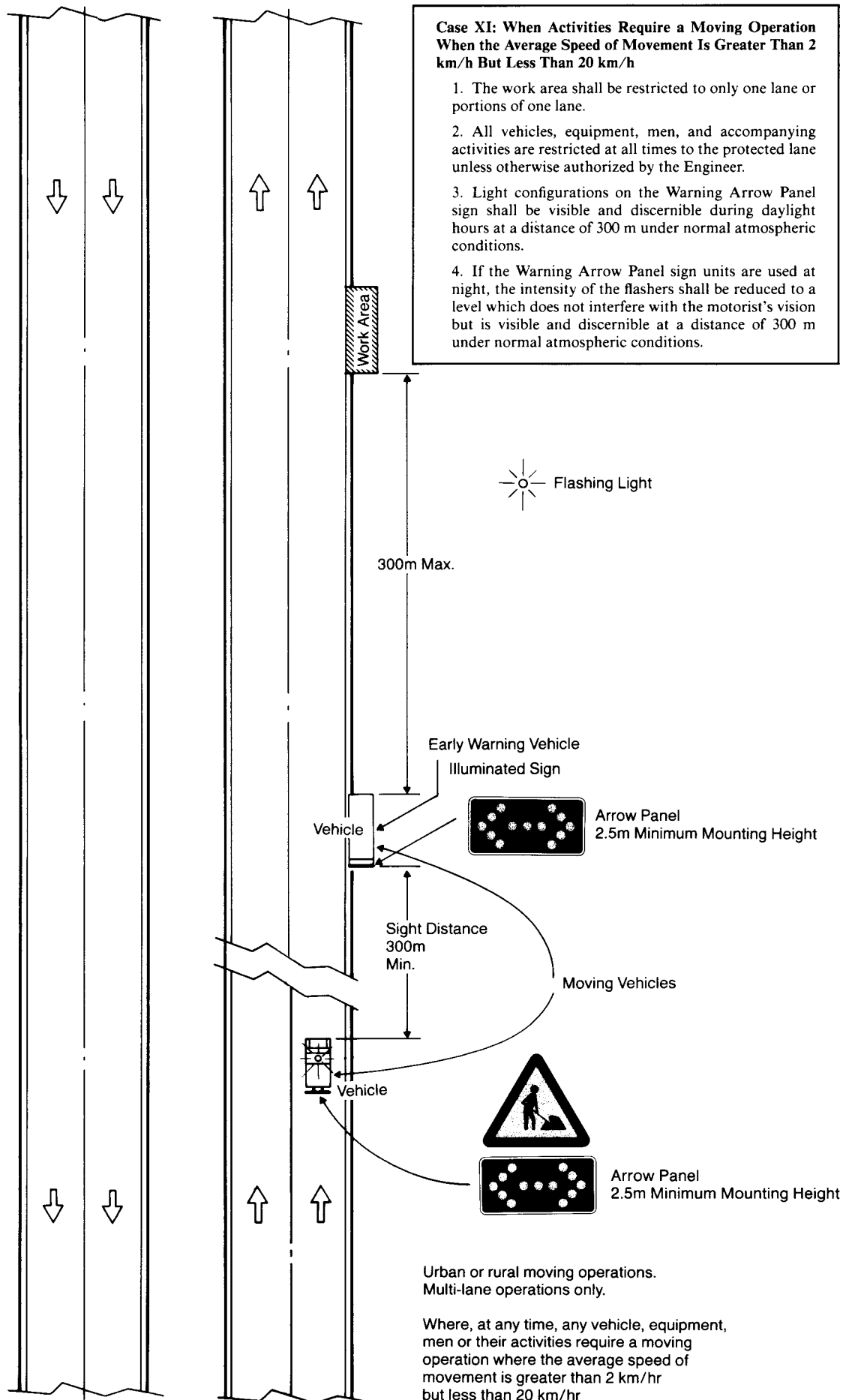
Case IX

**Case X: When Activities Require the Closure of Two Adjacent Lanes and a Temporary Detour Is Provided By Making Use of One Lane Normally Used By Opposing Traffic**

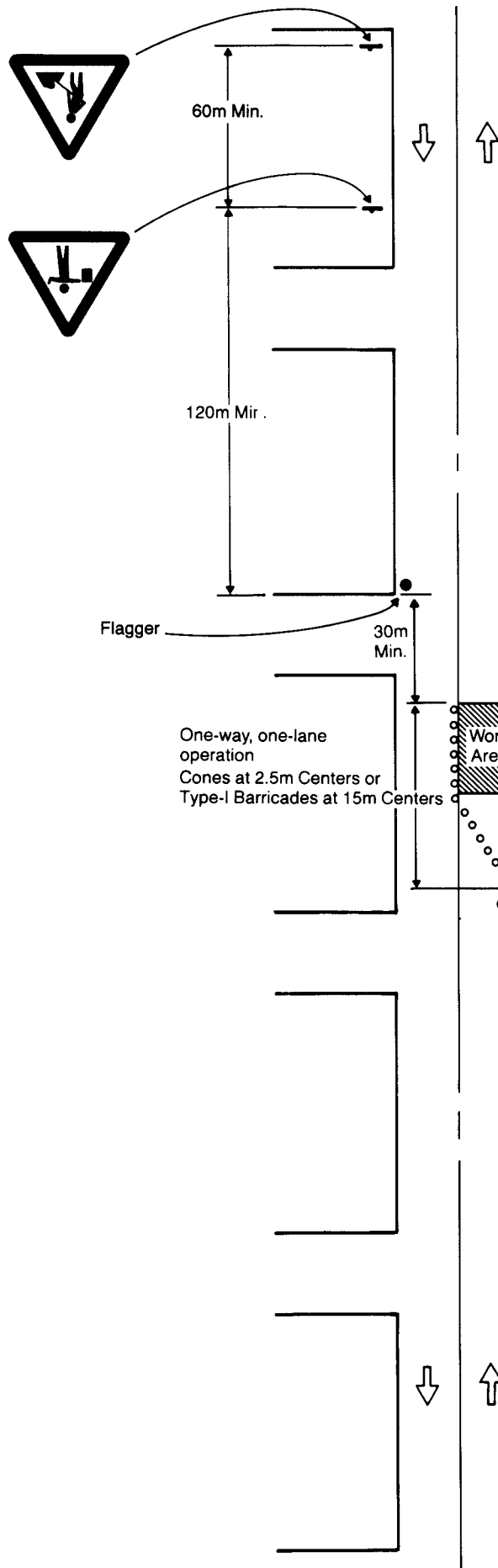
1. Pavement markings shall always be used on paved crossovers. Temporary pavement marking tape shall be used to mark a new center line and edge line on the existing pavement. All existing markings conflicting with the revised traffic pattern shall be removed.
2. Two-way Traffic sign(s) shall be repeated every 400 m in each direction through the tangent distance (T).
3. This case does not apply when work is being performed in the middle lane(s) of a six or more lane highway. Special plans approved by the Engineer will be required.
4. Cones may be substituted for barricades during day operations.
5. The "L" distance equals the lane width times the taper ratio shown on Channelizing Device Placement Table 5-1.



Case X



Case XI



**Case XII: When Activities Encroach on the Pavement, Requiring Closure of One Traffic Lane in an Area Where Speeds Are in a Lower Range Posted Zone**

1. Type I or Type II barricades, drums, or vertical panels with steady burning lights shall be used.
2. For operations within 15 m of an intersection, traffic handling plans shall be approved by the Engineer.
3. Where the work area extends through the intersection, barricades and adequate Warning signs shall be erected on the cross street.
4. If the work area is in the parking lane and the parking exists during work hours, a Road Work sign shall be installed a minimum of 60 m in advance of the work area and the area protected with cones or barricades.
5. If the work operation is performed during off peak periods and is of short duration, signing shall be in conformance with Case VII.
6. Construction operations shall be confined to one traffic lane, leaving the opposite lane open to traffic.
7. The flaggers shall be in sight of each other or in direct communication at all times. When a travel lane is closed, the flagman will be present whether work is performed or not performed.

**Symbols**

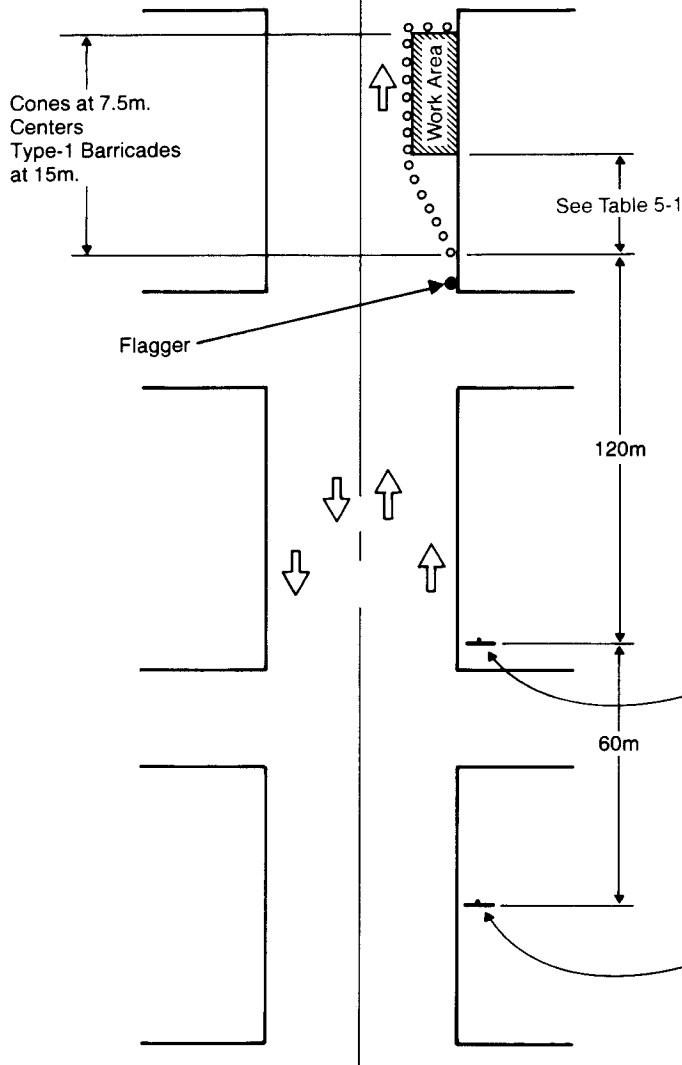
- Cones, steel drum (210 liters) or Type-I Barricade.
- Flagger with traffic control sign

Two-lane, two-way traffic, undivided urban day or night operations.

Where, at any time, any vehicle, equipment, men or their activities encroach on the pavement requiring the closure of one traffic lane in an area where the posted speed limit is 60 km/hr or less.

**Case XIII-A and Case XIII-B: When Activities Encroach on the Pavement, Requiring the Closure of at Least One Traffic Lane in an Area Where the Posted Speed Is 60 km/h or Less**

1. Type I or Type II barricades with steady burning lights shall be used in lieu of cones or steel drums for night operations.
2. For operations within 15 m of an intersection, traffic handling plans shall be approved by the Engineer.
3. Where the work area extends through the intersection, barricades and adequate Warning signs shall be erected on the cross street.
4. If the work area is in the parking lane and the parking exists during work hours, a Road Works sign shall be installed 200 m in advance of the work area and the area protected with cones or barricades.
5. Operations restricting vehicular movement, so traffic in both directions must use a single lane, shall only be allowed while flaggers are on duty or when a temporary traffic signal is installed to assign right-of-way.
6. This case does not apply when work is being performed in the middle lane(s) of a six or more lane highway. Special plans approved by the Engineer will be required.
7. For night operations, flashing lights shall be installed above the first sign on each approach.
8. Distances shown are minimums.



**Symbols**

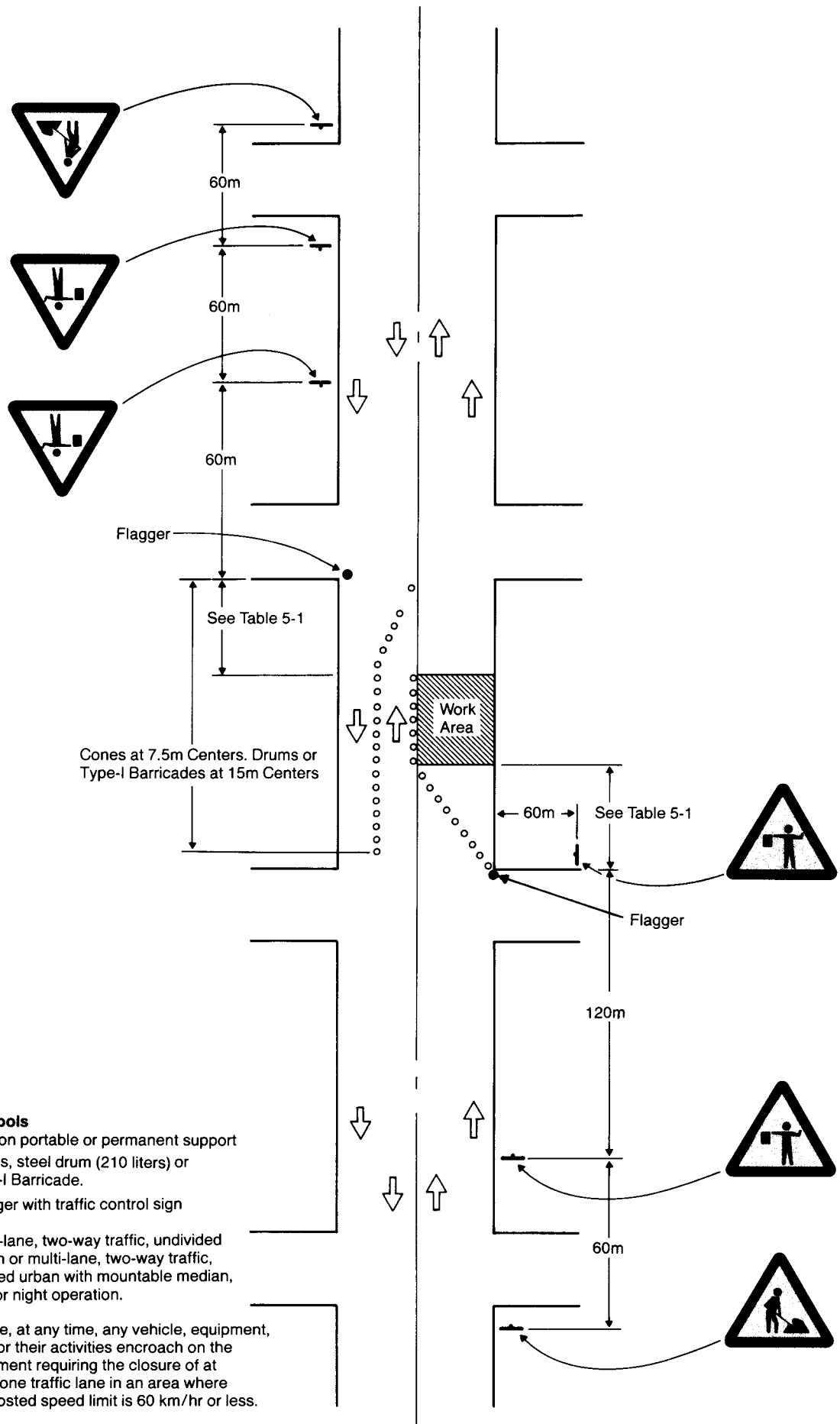
- ▲ Sign on portable or permanent support
- Cones, steel drum (210 liters) or Type-I Barricade.
- Flagger with traffic control sign

Multi-lane, two-way traffic, undivided urban or multi-lane, two-way traffic, divided urban with mountable median, day or night operation.

Where, at any time, any vehicle, equipment, men or their activities encroach on the pavement requiring the closure of at least one traffic lane in an area where the posted speed limit is 60 km/hr or less.



**Case XIII-A**



Case XIII-B



## **Part 6. Traffic Control for School Areas**

### **6.01 General Provisions**

#### **A. Need for Standards**

1. Pedestrian safety depends greatly upon public understanding of accepted methods for efficient traffic control. This principle is most important in the control of pedestrians and vehicles in the vicinity of schools. Neither school children nor vehicle operators can be expected to move safely in school zones unless they understand both the need for traffic controls and the ways in which these controls function for their benefit.

2. Nonuniform procedures and devices cause confusion among pedestrians and vehicle operators, prompt wrong decisions, and can contribute to accidents. In order to achieve uniformity of traffic control in school areas, common traffic situations must be treated in the same manner. Each traffic control device and control method described in this part fulfills a specific function related to specific traffic conditions.

3. The type of school area traffic control used, either warning or regulatory, must be related to the volume and speed of traffic, street width and the number of children crossing. Traffic controls necessary in a school area located on a major highway would not be needed on a local street away from heavy traffic. A uniform approach to school area traffic controls must be developed to assure the use of similar controls for similar situations.

4. A school route plan for each school should be developed consisting of a simple map showing streets, the school, existing traffic controls, established school routes, and established school crossings. The plan permits the orderly review of school area traffic control needs and the coordination of school pedestrian safety education and engineering activities.

#### **B. Criteria for School Crossing Control**

1. The safety of school children going to and from school depends greatly upon the care children use in crossing streets and highways. Children can safely cross minor streets without help if they have been taught to be careful in crossing. Traffic control devices to help children cross streets should be used only when necessary. Standard devices should be used because motorists recognize them and watch for children crossing.

2. School crossing safety problems exist in villages and in rural areas as well as in cities.

In village and rural areas the dangers are caused by the higher speed of vehicles as well as the amount of traffic. The traffic control discussed in this section apply to villages and rural areas as well as the larger cities. Where the word "street" is used, it is intended to include all highways unless the context clearly indicates otherwise.

3. Traffic proceeds along a street in groups of vehicles. Between the groups are gaps with few or no vehicles. Pedestrians can cross the street during these gaps in traffic if the gaps are of sufficient length. (See the Glossary for a definition of the term "gap.") As traffic becomes heavier, these gaps become shorter and less frequent. When the time between gaps long enough for safe crossing becomes too great, children become impatient. They will attempt to cross the street when it is not safe to do so and may be hit by a vehicle.

4. The number of gaps long enough for safe crossing must not be less than an average of one safe gap per minute. If children have to wait much more than a minute, they will attempt to cross the street despite the presence of traffic. Thus, some form of traffic control is needed to help the children to cross if safe gaps do not occur at least once a minute on the average. The traffic control may be police officers or traffic control signals.

5. A traffic policeman is desirable where many of the children who cross are quite young, between 5 and 10 years old. Children of that age do not have the judgment required to determine when it is safe to cross. Even if a signal is installed, a traffic policeman may be desirable if many children want to cross or do not obey the pedestrian signal indications.

#### **C. Engineering Study Required**

1. Two items of information are needed for a decision on whether or not some form of traffic control is needed to help school children cross a street: (a) the length of gap adequate for the number of children crossing and (b) the frequency of adequate gaps.

2. The length of adequate gap can be determined by a short field study. Children tend to cross a street in groups, and in rows, if more than five cross at the same time. The number of rows is roughly dependent upon the number of children in the group.

3. The number of groups of each size which cross during the school crossing survey period can be observed and recorded on a form similar to that shown in Figure 6-1.

4. The number of rows of crossing children in the 85 percentile group size is calculated as shown in Figure 6-1. Then using the number of rows and the street width, Table 6-1 can be entered to determine the adequate gap time in seconds. The Table is based on the formula:

$$G = \frac{W}{3.5} + 3 + 2(N-1)$$

where  $\frac{W}{3.5}$  is the time required by children to cross a street of width W (meters);

N is the number of rows from Table 6-1; and

3 is the number of seconds required for children to look both ways before crossing the street.

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### Pedestrian Group Size Study

Study date 8-Safar, 1398 Time: From 7:00 AM to 9:00 AM Location Manfeha Rd. at MAKKAH Rd.

Crosswalk across Manfeha Rd. Curb-to-curb distance 28 m.

Divided roadway? Yes ☒ No ☐ Width of island       

Group Size	Number of Rows (N)	Number of Groups		Cumulative		Computations
		Tally	Total	Groups	% Total	
46 — 50	10					This figure includes the 85th percentile group size. Therefore: N = 6
41 — 45	9					
36 — 40	8	/	1	60	100	
31 — 35	7	///	3	59	98	
26 — 30	6	### //	7	56	93	
21 — 25	5	### ### ///	13	49	82	
16 — 20	4	### ### ### ///	18	36	60	
11 — 15	3	### ### //	12	18	30	
6 — 10	2	###	5	6	10	
5 or less	1	/	1	1	2	
Total Number of Groups			60			N = 6

Figure 6-1  
School crossing survey form.

**Table 6-1**

**Table of Adequate Gap Times  
(in seconds)**

Roadway Width-W (m)	Number of Rows-N									
	1	2	3	4	5	6	7	8	9	10
5-6	8	10	12	14	16	18	20	22	24	26
6-7	9	11	13	15	17	19	21	23	25	27
7-8	10	12	14	16	18	20	22	24	26	28
8-9	11	13	15	17	19	21	23	25	27	29
9-10	12	14	16	18	20	22	24	26	28	30
10-11	13	15	17	19	21	23	25	27	29	31
11-12	14	16	18	20	22	24	26	28	30	32
12-13	15	17	19	21	23	25	27	29	31	33
13-14	16	18	20	22	24	26	28	30	32	34
15-16	17	19	21	23	25	27	29	31	33	35
16-17	18	20	22	24	26	28	30	32	34	36
17-18	19	21	23	25	27	29	31	33	35	37
18-20	20	22	24	26	28	30	32	34	36	38
20-22	22	24	26	28	30	32	34	36	38	40
22-24	25	27	29	31	33	35	37	39	41	43



## 6.02 Signs and Markings

### A. Design of Signs

Uniformity of design includes shape, color, dimensions, symbols, wording, lettering, and illumination or reflectorization. The principles and standards set forth in Part 2 of this Manual regarding these design characteristics apply in school area signing.

### B. School Warning Sign (W 12)

Intended for use to give warning of a section of road frequented by children going to and from school. The W 12-1 sign shall be used as an Advance Warning sign. If children are crossing at a marked crosswalk, a supplementary sign (W 12-2) illustrating the crosswalk lines can be used. This supplementary sign shall be located immediately adjacent to the crossing location.



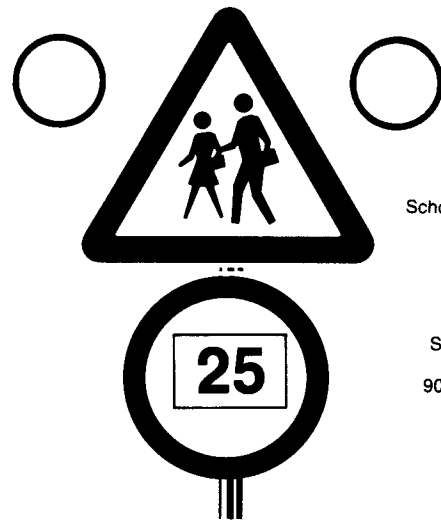
School Warning  
W 12-1



School Crossing  
W 12-2

### C. School Speed Limit Sign (R 3-1/W 12-1)

1. The School Speed Limit sign shall be used to indicate the speed limit where a reduced speed zone for a school area has been established after an engineering and traffic investigation.
2. The fixed message sign assembly shall consist of a School Warning sign (W 12-1). The Speed Limit sign will be a variable message sign that will display the permanent speed limit and the school speed limit for only during those periods of time children are going to and from school.
3. All School Speed Limit sign assemblies shall be equipped with two 200 mm alternately flashing yellow beacons. These beacons shall be flashing whenever the school speed limit is in effect. The design and operation of these beacons shall be in conformance with Section 4.07E.
4. For traffic leaving a school zone or a school crossing at a school, a sign giving the speed limit for the following highway section or an End Speed Limit sign (R 13/3-1) shall be posted.



School Warning  
W 12-1

Speed Limit  
R 3-1  
900 Diameter

### D. Parking Prohibited and Parking Restricted Signs (R 14)

Prohibiting or restricting parking during periods of the day when children are going to and from school may be necessary to assure that children have adequate access to the crossing. The restricted area should extend far enough in advance of the crossing to provide the driver with adequate visibility of the children.

R 14-1 indicates places where parking is prohibited at all times.

R 14-2 indicates places where there is restricted parking with the specific limitation shown on a supplemental plaque mounted below the symbol sign.



Parking Prohibited  
R 14-1  
900 Diameter



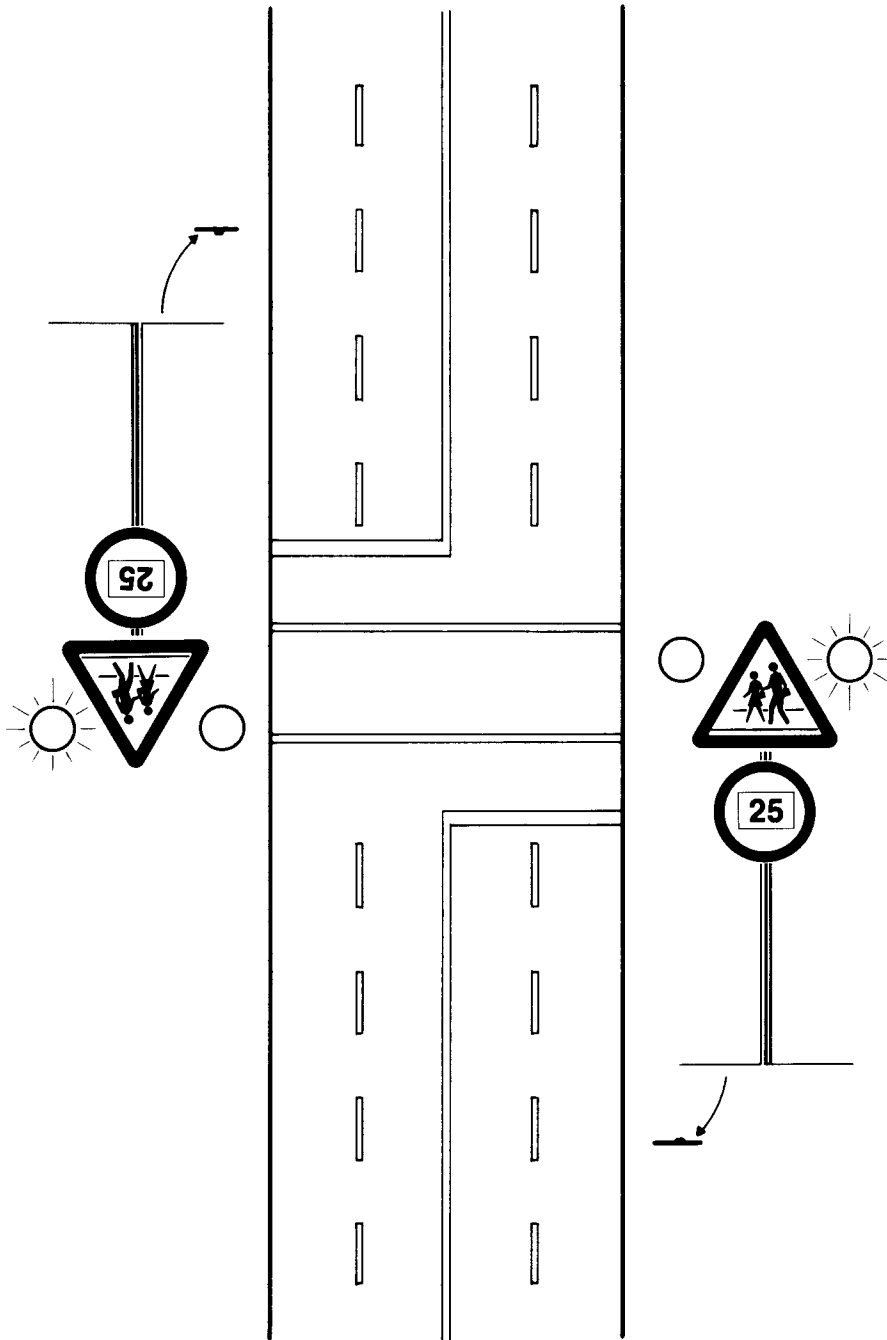
Parking Restricted  
R 14-2  
900 Diameter

## E. Pavement Markings

1. Markings as discussed in Part 3 for stop lines, crosswalk lines and curb markings for parking restrictions have application in school areas.
2. Markings perform an important function in a proper scheme of school area traffic control. In some cases they are used to supplement the regulations or warnings of other

devices such as traffic signs.

3. Crosswalks should be marked at all intersections on established routes to school where there is significant conflict between vehicles and elementary students (while crossing), where students are permitted to cross between intersections, or where students could not otherwise recognize the proper place to cross.



**Figure 6-2**  
**School speed limit folding sign installation.**

## 6.03 School Area Traffic Control Signals and Flashers

### A. General—Standards

1. School Crossing signals are standard traffic control signals installed at authorized school crossings to create needed gaps for pedestrians to cross the stream of vehicles.
2. Properly designed, installed, operated and fully warranted School Crossing signals have the following advantages:
  - a. Over a period of several years these devices are more economical than police supervision.
  - b. It may be possible to coordinate these devices with adjacent signals so as to minimize the number of vehicles which are stopped by the school signals.
3. On the other hand, a School Crossing signal may have some or all of the following disadvantages:
  - a. It has a high initial cost.
  - b. Supplemental control by a policeman may be required, especially for very young children.
  - c. It requires routine and emergency maintenance and must be kept in good working order.
4. The design, installation, and operation of School Area Traffic Control Signals shall conform to the standards for traffic control signals set forth elsewhere in this Manual except as modified by this Part.

### B. Criteria for School Crossing Traffic Control Signals

The criteria useful in determining whether or not to install a School Crossing Traffic Control signal are found in Section 4.02 F.

### C. Intersection and Nonintersection Traffic Control Signal Installations

1. School Traffic Control signals installed at intersections have the following characteristics:
  - a. Motorists are accustomed to stopping for traffic control signals at intersections.
  - b. Generally children use cross streets to get to school.
  - c. An intersectional traffic control signal installed for school children may be equipped with vehicle detectors to help side street traffic to enter the major street.
  - d. Side street traffic turning right or left across the crosswalk may be a hazard to school children.

- e. The additional equipment for side street control adds to initial, operating, and maintenance costs.
2. School Crossing signals installed at crosswalks between intersections have the following characteristics:
  - a. Additional hazards may occur because motorists do not expect traffic control signals or crosswalks between intersections.
  - b. The amount and complexity of traffic control signal equipment needed are less than for a signal at an intersection.
  - c. There are no turning vehicles to cause a hazard to pedestrians.

### D. Design and Location of School Crossing Signals

1. Pedestrian indications and pedestrian pushbutton detectors shall be placed at each end of school crosswalk.
2. Traffic control signals installed at intersections under the School Crossing Signal criterion shall be either semi or fully traffic actuated, unless incorporated in a progressive signal system. Vehicular signal indications shall be provided for side street traffic. Vehicle detectors shall also be installed on the side street unless the signal is pretimed in a progressive signal system.
3. A School Crossing signal at a location between intersections shall be at least 30 m from the nearest intersection or 150 m from the nearest signal (Section 4.02F-2.d.). Such a signal shall be pedestrian actuated.
4. Whether or not installed at an intersection, a School Crossing signal shall be coordinated with a progressive signal system on that street. School Crossing signals not at an intersection in such systems shall not stop traffic unless there is a pedestrian actuation.
5. School Crossing signals shall be designed and installed in accordance with the requirements for other traffic control signals (See Section 4.04 and Figure 4-18).

### E. Operation of School Crossing Traffic Control Signals

1. School Crossing signals at intersections shall usually permit school children to cross a street at the same time vehicles moving in the same direction are allowed to proceed. This will allow vehicles turning left or right to cross the school crosswalk. However, when pedestrians are using the crosswalk, it

is illegal for vehicles to interfere with their movement. If drivers do not obey this law, then the pedestrian indications can be shown 5 seconds or more before vehicles on the same street receive the green indication. This will allow pedestrians to begin walking before vehicles can start, and drivers will be less likely to interfere with pedestrian movement.

2. Alternatively, by the use of appropriate arrow indications, only the vehicles not crossing a school crosswalk would be allowed to go. Then the vehicular signal indications could change to GREEN DISK, permitting all vehicle movements from that approach. An exclusive pedestrian phase, during which all vehicles are stopped and pedestrians may use all crosswalks, is possible. However, such a procedure usually results in considerable unnecessary delay to vehicular traffic. It shall be used only when adequate trial of other less restrictive types of operation have not resulted in safe conditions for school children and other pedestrians.

3. At school crossings between intersections, pedestrians have no interference from side street vehicles. However, drivers may fail to see the signal indications.

Therefore, a short (approximately 3-second) RED clearance interval shall follow the YELLOW CHANGE indication before the pedestrian Walk indication is shown.

4. The timing of School Crossing signals shall be adjusted to assure that the children have sufficient time to safely cross the roadway.

5. School Crossing criteria may be met after a traffic signal has been in operation at an intersection for some time. In such cases, pedestrian signal indications shall be installed if not already present, and Advance School Crossing and School Crossing signs shall also be installed. The pedestrian phase shall be pedestrian actuated if possible, and pushbuttons and necessary auxiliary control equipment shall be installed.

6. School Crossing signals that do not meet other criteria shall operate as stop-and-go devices only during those days and hours when school children may be going to and from school. The signals shall be controlled by a 7-day programmable time clock or other reliable means, which will cause the signals to be in the flashing mode at other times. When the vehicular indications are flashing, the pedestrian indications shall not be shown.

## **Part 7. Traffic Control Systems for Railroad Grade Crossings**

### **7.01 General Provisions**

#### **Requirements for Railroad Grade Crossings**

Traffic control systems for railroad grade crossings include all signs and signals and their supports along highways approaching and at railroad grade crossings.

1. The function of traffic control systems for railroad grade crossings is to provide safe and efficient operation of rail and highway traffic over the crossings.
2. All traffic control devices used at railroad grade crossings shall comply or be consistent with the standards contained in this Manual.
3. The railway and the highway jointly occupy the area of a railroad grade crossing in conducting their assigned responsibilities. They have joint responsibility for the traffic warning and control devices at the crossing. The determination of the need for and the selection of the devices at the crossing shall be made by the highway authority.
4. No signal shall be placed within the traveled way except on an island with barrier curbing, guardrail, or other device to

adequately protect motorists from injury.

5. Where practicable, enclosures for railroad grade crossing signal control equipment shall be placed at least 10 m from the edge of the roadway. Enclosures should also be placed so that motorists can see oncoming trains.
6. Where the distance along the highway between tracks is 30 m or more, separate crossing warning signals shall be installed for each crossing.
7. Railroad maintenance and operational procedures should not unduly inconvenience or delay highway traffic, or result in increased accident potential. Highway authorities and the Saudi Government Railroad Organization (SGRRO) shall consult and plan for detours, alternative crossings, signing, marking, flagging, and other warning and control during any work at the railroad crossing. When a railroad track is abandoned or discontinued, all traffic control devices should be removed, and the track should be removed or covered.



## 7.02 Signs and Markings

### A. Purpose

Passive traffic control devices, consisting of signs and pavement markings, identify and direct attention to the location of a railroad grade crossing to permit vehicle operators and pedestrians to take appropriate action.

### B. Railroad Crossing With Gates (W 23-1)

Intended for use to give warning of an approach to a railroad crossing with gates or staggered half-gates on either side of the railway line.

### C. Railroad Crossing Without Gates (W 23-2)

Intended for use to give warning of an approach to a railroad crossing not protected by gates.

### D. Location of Railroad Crossing (W 23-3)

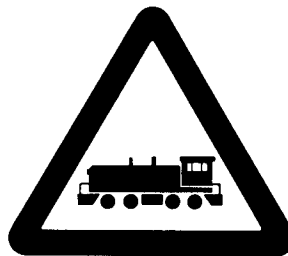
Crossarm signs are to be in the immediate vicinity of railroad crossings.

### E. Pavement Markings

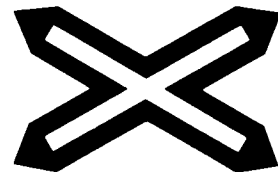
Pavement markings consisting of an X, no-passing marking (two-lane roads), and certain transverse lines may be placed in advance of railroad crossings where engineering studies indicate there is significant potential conflict between vehicles and trains. At minor crossings or in urban areas, these markings may be omitted if the engineering study indicates that other devices installed provide suitable control. (See Figure 7-1).



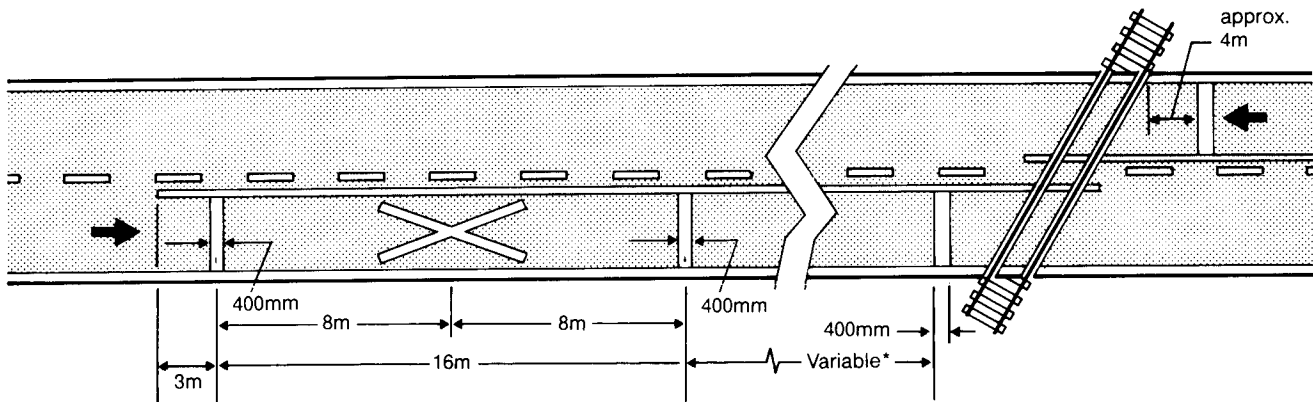
Railroad Crossing  
with Gates  
W 23-1



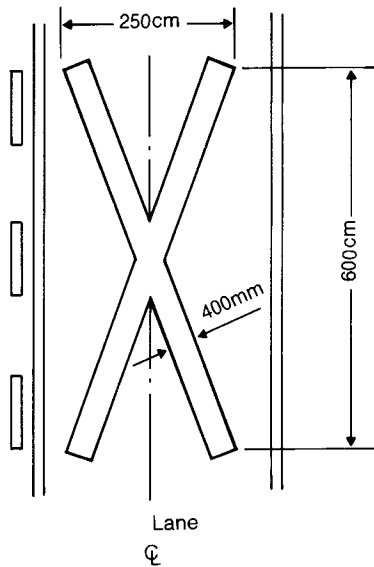
Railroad Crossing  
without Gates  
W 23-2



Railroad Crossing  
W 23-3  
1200x1200



Width may vary according to lane width.



\*The distance from the railroad crossing marking to the nearest track will vary according to the approach speed and the sight distance of the vehicular traffic approaching, but probably should be not less than 15m.

On multi-lane roads the transverse bands should extend across all approach lanes, and individual X symbols should be used in each approach lane.

**Figure 7-1**  
**Typical pavement markings at railroad grade crossings.**

## 7.03 Signals and Gates

### A. Purpose

Active traffic control systems inform vehicle operators and pedestrians of the approach or presence of trains, locomotives, or railroad cars on the railroad crossing. These traffic control systems include flashing light signals and automatic gates.

### B. General

1. The optical units, signs, gate arms, and supports for flashing light signals shall be essentially as shown in Figures 7-2 through 7-6. However, a flashing light system using two optical units spaced not less than 600 mm apart, but otherwise as shown in the Figures, may be accepted by the Ministry.
2. The flashing light units, whether post-mounted, on a cantilever or used with a crossing gate, shall have the following characteristics:
  - a. Two optical units which shall be illuminated alternately.
  - b. The optical units shall be illuminated at least 35 and no more than 85 times per minute.
  - c. Each of the two optical units shall be illuminated approximately half of the total time of operation.
  - d. Two nominal sizes of lenses, 200 mm and 300 mm are available for flashing light units. The 300 mm lens shall be used for all railroad grade crossings except on minor local streets and highways.
  - e. The optical characteristics of the flashing light units shall be similar to the characteristics of traffic control signal optical units.

### C. Flashing Light Signal—Post Mounted

1. To give warning of the approach or presence of a train, the flashing light signal shall show two alternately flashing red lights to approaching highway traffic. These red lights shall be horizontally aligned. The signal assembly shall include a W 23-3 sign. A bell which rings when the lights are flashing shall be included in the signal assembly where a considerable number of pedestrians or driven animals are present. A typical post-mounted flashing light signal is shown in Figure 7-2.
2. When used, flashing light signals shall normally be placed on the right-hand side of each approach to a railroad grade crossing. The position with respect to the roadway

shall be as illustrated in Figure 7-5. If the signal does not have good visibility in the normal location, an additional signal located for better visibility should be installed.

3. At railroad grade crossings on two-way highways without a median or having a median not wider than 3 m, a flashing light signal shall consist of two sets of flashing lights and signs. The lights and signs shall be mounted back to back on the same support. A flashing light signal unit shall face traffic approaching the railroad grade crossing from each direction.

4. Where the approach has more than two lanes, the flashing light signals shall be cantilevered over the roadway as shown in Figure 7-3. Guardrails or impact attenuators may be needed to protect motorists from signal supports, because the supports cannot be of breakaway design.

5. Additional pairs of flashing red lights will be needed when streets intersect at or near a railroad grade crossing, and where roadways run near and parallel to the railroad. The additional flashing red lights shall normally be mounted on the same support as the regular signals, but they may be placed on another support. The additional flashing red lights shall be directed at traffic approaching the crossing from a direction other than along the principal street at the railroad grade crossing.

6. Upon detection of the approach of a train (Section 7.03 G), the lights of a flashing light signal shall begin to flash alternately. These lights shall continue to flash as long as a train is approaching or on the railroad grade crossing.

### D. Flashing Light Signal—Cantilever Mounted

1. Cantilever-supported flashing light railroad grade crossing signals are illustrated in Figure 7-3. This signal shall be used on multi-lane highways. It may also be used instead of post-mounted signals at the following locations where better visibility of the signal is needed:

- a. High speed rural highway.
- b. Two-lane highways carrying high traffic volumes.
- c. Locations, such as in urban areas, where there are distracting lights or other conditions.

2. The flashing operation of cantilever-supported flashing light signals is the same as for post-supported signals.

3. In addition to the flashing lights on the cantilever arm, one pair of flashing lights shall be placed on the supporting post. Normally, two pairs of flashing lights shall be placed on the cantilever arm, one facing in each direction. A pair of flashing lights is not required over each approach lane.

4. Breakaway bases shall not be used for cantilever supports. Where there is no curb, guardrails or impact attenuators shall be used to protect motorists from signal supports. The supporting pole for a cantilever signal shall be set not less than 2 m from the edge of the roadway where there is no curb. All parts of the signal that are over the roadway shall be at least 5.8 m above the road. All lower parts of the signal shall be at least 0.5 m back of the curb.

#### **E. Automatic Gates**

1. An automatic gate has an arm of a breakable material which extends across all approach lanes at a railroad grade crossing when the signal is warning of the approach or presence of a train. The gate is in addition to flashing light signals, and its operating mechanism may be incorporated with the signals or may be on a separate standard. A typical automatic railroad grade crossing gate and flashing light signal is shown in Figure 7-4.

2. In the lowered position, the gate arm shall be between 1.0 m and 1.35 m above the surface of the pavement. The gate arm shall have at least three red lights, two of which shall flash alternately. On long gate arms, additional lights shall be used. The gate arm shall have alternate high-reflectivity white and red diagonal markings as shown in Figure 7-4. When the signal is activated, the gate arm light nearest the tip shall be steadily illuminated. The other two lights shall flash alternately in unison with the principal flashing light signals.

3. In its normal upright position, the gate arm shall be practically vertical. The arm shall have a minimum clearance of 0.5 m from the face of the curb or edge of a paved or surfaced shoulder. Where there is no curb, it shall have a clearance of at least 2 m from the edge of the traveled way. When locating a gate on a median, the additional width required by the gate arm, its mechanism, and counterweights shall be considered. Figure 7-5 illustrates these clearances.

#### **F. Operation of Railroad Grade Crossing Signals and Gates**

1. When a railroad grade crossing warning system, including both flashing light signal and automatic gate types, is actuated by an approaching train, the following sequence of operation shall occur:

a. The flashing light signals and the lights on the gate arm shall commence to flash. Two lights per arm shall flash and all other lights on the arm shall burn steadily.

b. Not less than 3 seconds after the lights begin to flash, the gate arm shall begin to descend from its normal upright position to a horizontal position. It shall reach the horizontal position before the train reaches the crossing. It shall remain horizontal as long as the train occupies the crossing.

c. When the train leaves the crossing, and if no other train is approaching the crossing, the gate arm shall rise to its vertical position. Normally, this shall not require more than 12 seconds. All lights shall continue to flash during this period.

d. When the gate arm reaches the vertical position all lights shall be extinguished.

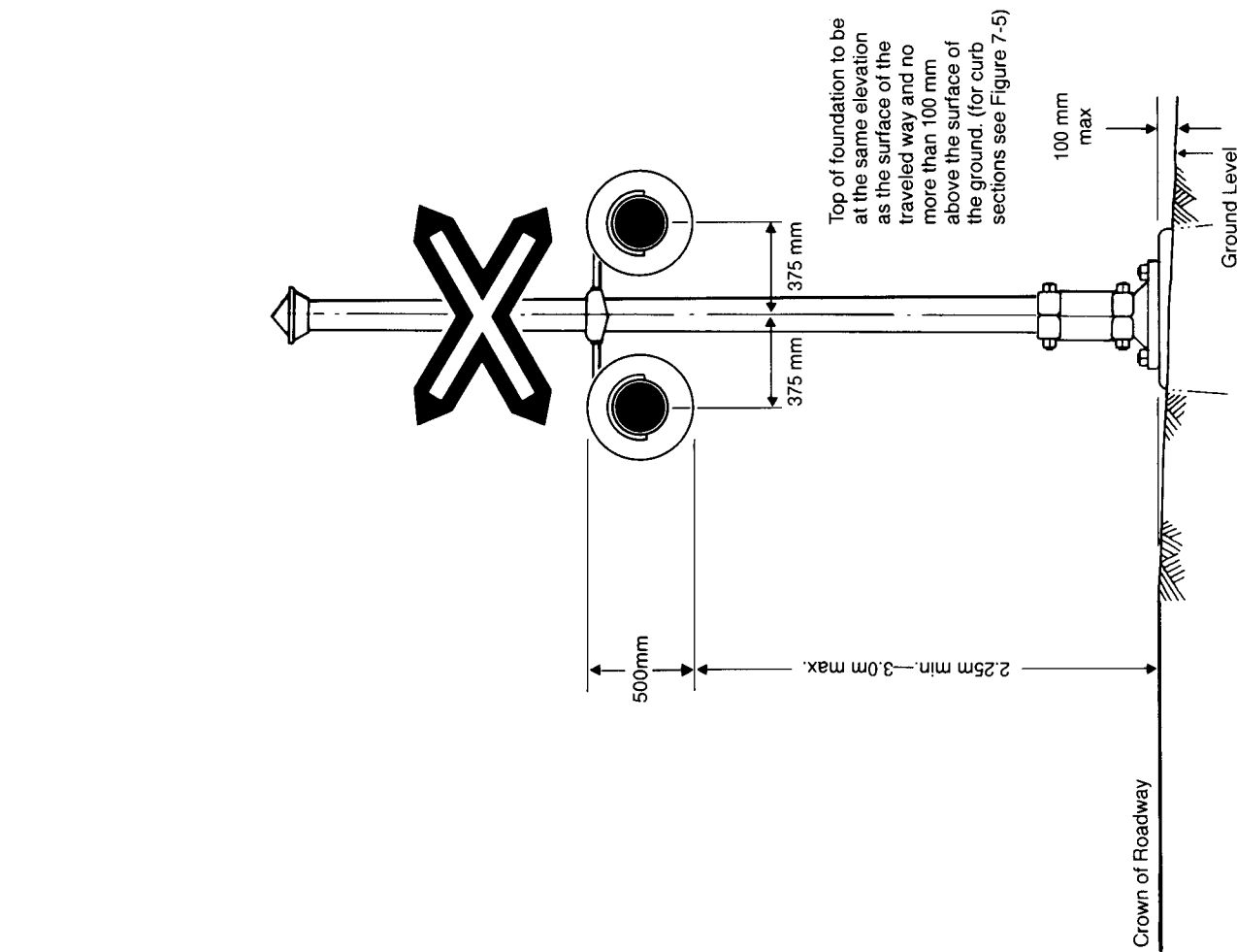
2. In the design of individual installations, consideration shall be given to timing the operation of the gate arm to accommodate slow moving highway vehicles. Gate arm operation shall also be coordinated with the operation of traffic signals at nearby intersections.

3. Typical location plans for automatic gates at railroad grade crossings are given in Figure 7-6.

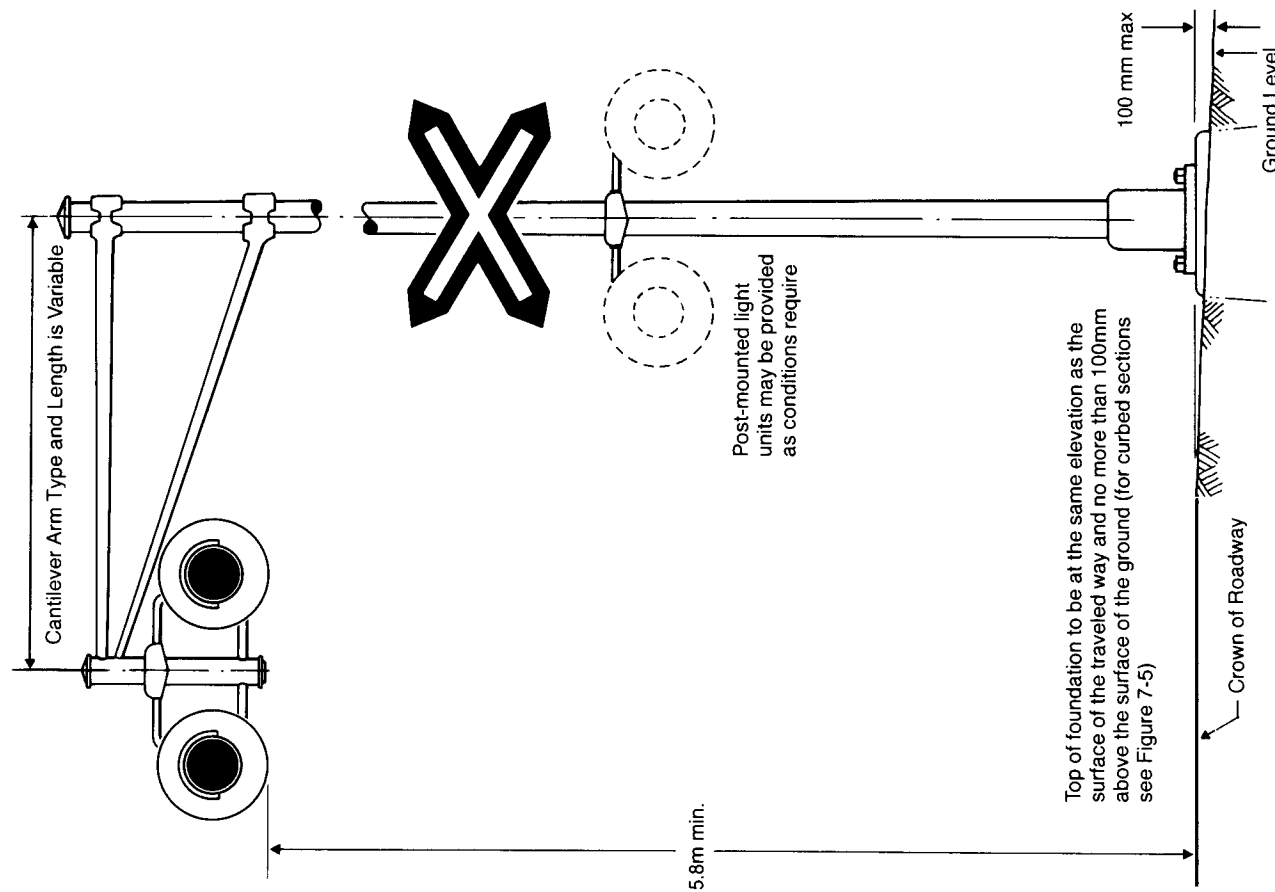
#### **G. Train Detection for Railroad Crossing Signals and Gates**

1. The flashing light signals and gates at railroad grade crossings shall be activated by equipment and electrical circuits upon the approach of a train. These circuits shall be designed to be "fail-safe," that is, any electrical or mechanical failure of equipment shall cause the warning indications to be displayed to traffic approaching the crossing.

2. On tracks where trains operate at speeds of 30 km/h or higher, the control equipment and circuitry shall activate the flashing light signals at least 20 seconds before any train arrives at the crossing. Where the speeds of different trains approaching a crossing vary widely, special devices and circuits should be installed. These devices should assure that

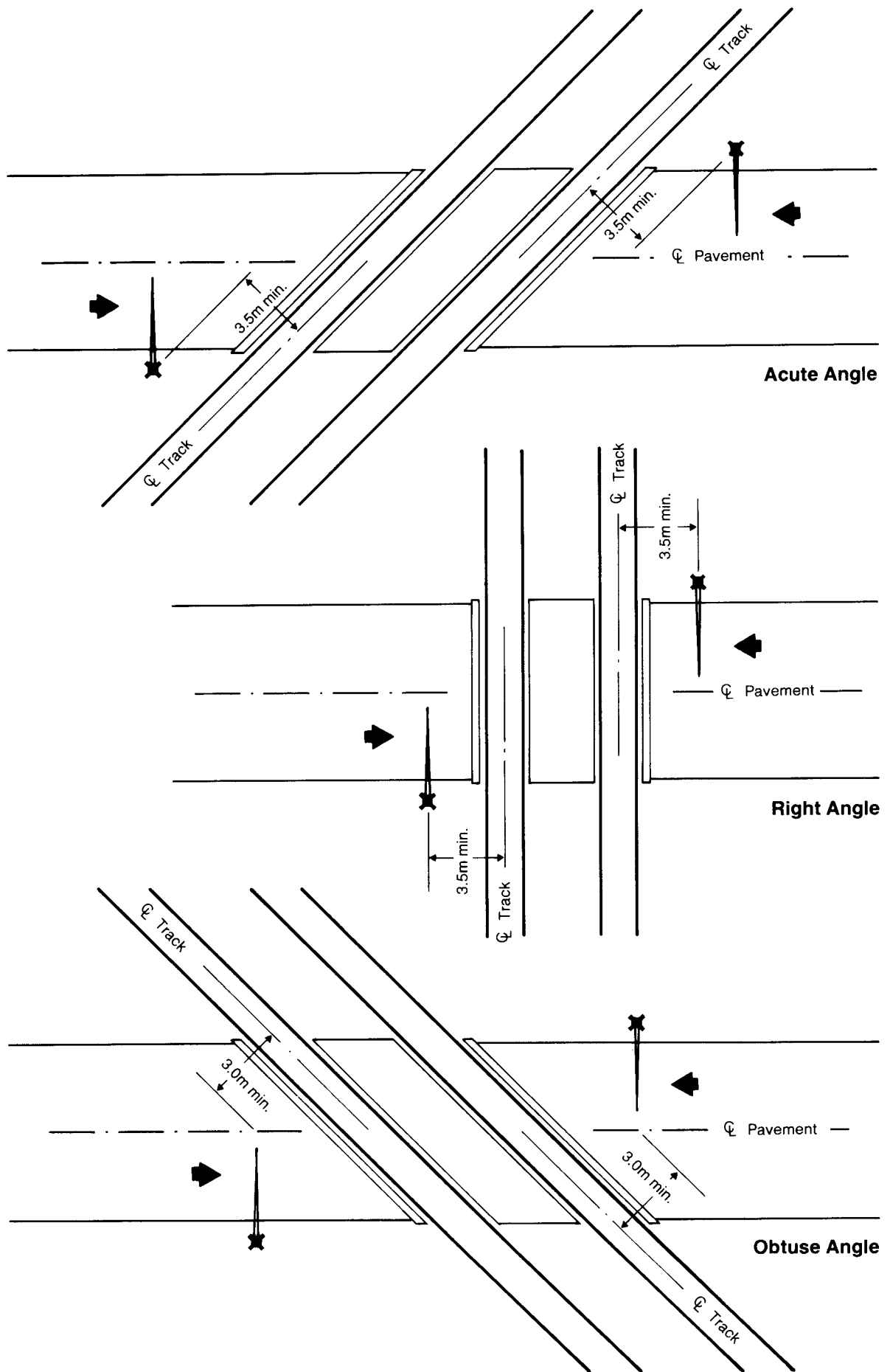


**Figure 7-2**  
Typical flashing light signal—post mounted.



**Figure 7-3**  
Typical flashing light signal—cantilever supported.





**Figure 7-6**  
**Typical location plan for flashing light signals and automatic gates.**

the crossing warning signals will begin operating about the same length of time before a train arrives at the crossing, no matter what its speed.

3. Manual controls to override the automatic equipment may be necessary for railroad grade crossings near stations and in railroad switch yards.

4. The subject of automatic railroad grade crossing control is complex and only the most frequently encountered situations can be covered in this Manual. Considerable additional literature is available and should be consulted for any unusual situation.

## **H. Traffic Control Signals Near Railroad Grade Crossings**

1. Traffic control signals at intersections within 60 meters of railroad grade crossings shall be electrically interconnected and coordinated with the signals or gates which protect traffic at those crossings. This interconnection shall be made "fail-safe" by having a normally-closed electrical circuit between the railroad grade crossing equipment and the traffic signal controller. If this circuit opens, the traffic control signals at the intersection shall operate as though a train were approaching.

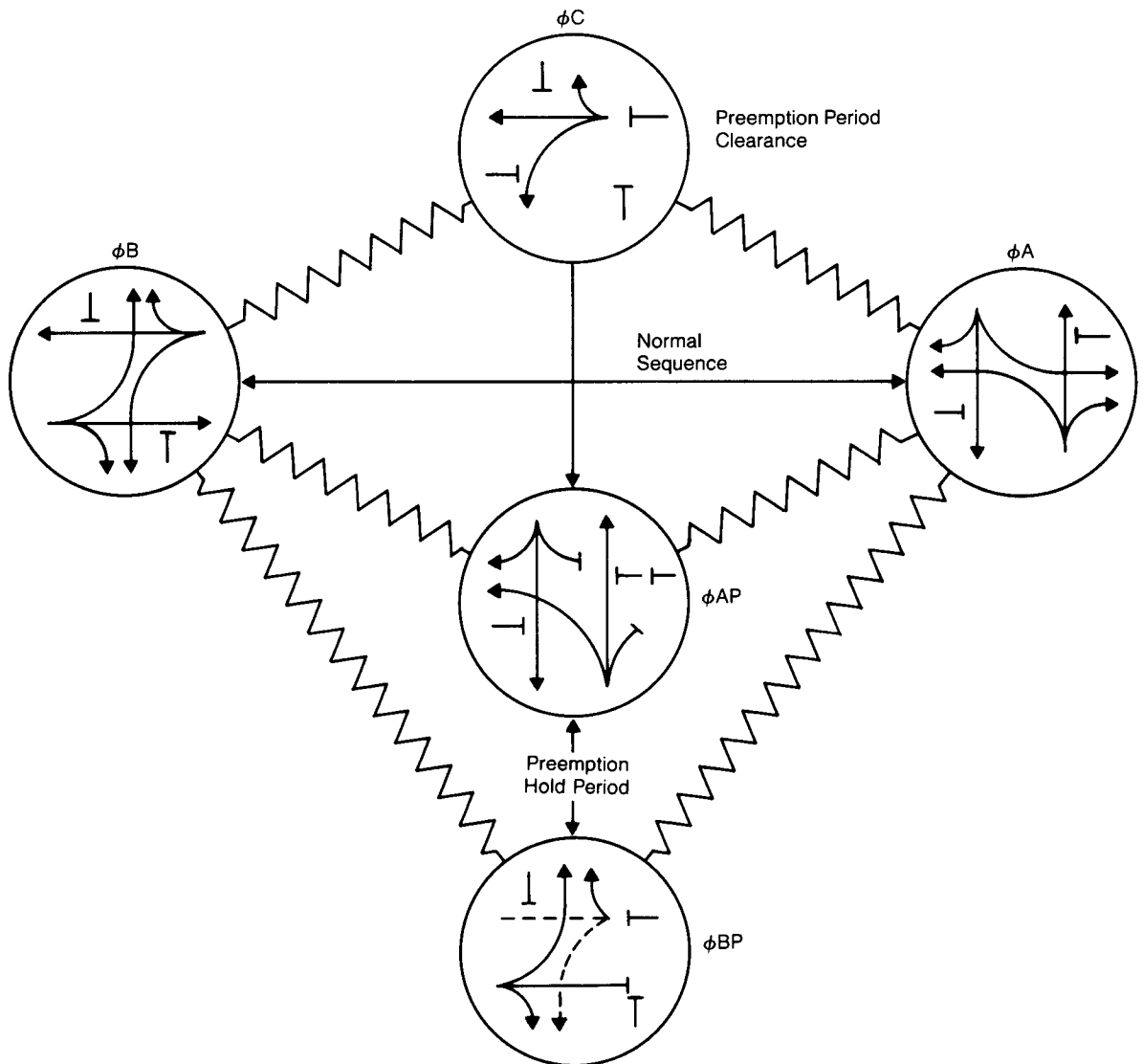
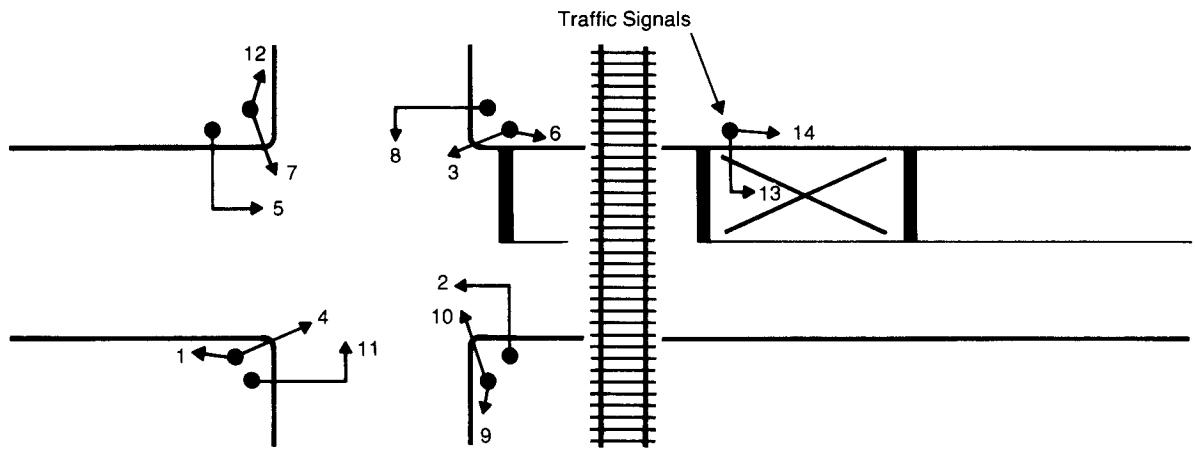
2. When an approaching train activates the railroad grade crossing warning mechanism, a prearranged sequence of traffic control signal operation shall immediately be started at the adjoining intersection. Vehicle change and clearance periods shall not be shortened. Pedestrian clearances may be shortened if

necessary to promptly activate signal indications to clear vehicular traffic from the tracks. After normal change and clearance periods, the signal shall show indications that will stop traffic from moving toward the railroad grade crossing from the intersection. At the same time, signal indications shall be given to permit traffic to move off the tracks at the railroad grade crossing. A red traffic control signal indication shall be given to vehicles which have not entered the railroad grade crossing. When no train is approaching the crossing, this signal shall show a flashing yellow indication.

3. After the track-clearance interval, the normal sequence of signal indications shall resume. (See Figure 7-7 and Table 7-1.) Alternatively, flashing yellow indications shall be shown to traffic on the street parallel to the tracks, and red indications on the cross street. (See Figure 7-8 and Table 7-2.)

4. At signalized intersections within 30 m of a railroad grade crossing, turning movements toward the crossing shall be prohibited when the signal is preempted by a train.

No Right Turn or No Left Turn signs, as appropriate, shall be used for this purpose. The sign display mechanism shall be designed so the message is visible to traffic only when the movement must be prohibited. However, signal indications or signs may allow straight through, right, or left movements of vehicles toward the railroad grade crossing if the distance is sufficient for vehicle storage between the intersection and the crossing.



**Figure 7-7**  
 Typical preemption sequence when signal continues to alternate the right-of-way during the preemption hold period.

Table 7-1

## Typical Preemption Sequence When Signal Operates Stop-and-Go During Preemption Hold Period

Indications In Each Signal Face		● ● ⤴	● ● ⤴	● ● ⤴	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● ●	● ● NRT	● ● NRT	● ● NLT	● ● NLT	● ● ●		
Phase	Signal Face No.	1	(H) 2	3	4	(H) 5	6	13	14	7	(H) 8	9	10	(H) 11	12		
∅A	R/W	●	●	●	●	●	●	◐	◐	●	●	●	●	●	●		
	Clear To	∅B	●	●	●	●	●	◐	◐								
			●	●	●	●	●	●	◐	◐	●	●	●	●	●		
		∅C	●	●	●	●	●	●				NRT	NRT	NLT	NLT		
●	●		●	●	●	●	●	●	●	●	NRT	NRT	NLT	NLT	●		
∅B	R/W	●	●	●	●	●	●	◐	◐	●	●	●	●	●	●		
	Clear To	∅A						◐	◐	●	●	●	●	●	●		
			●	●	●	●	●	●	◐	◐	●	●	●	●	●		
		∅C				●	●	●			●	●	●	●	●	●	
●	●		●	●	●	●	●	●	●	●	NRT	NRT	NLT	NLT	●		
∅C	R/W	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
	Clear To	∅AP	●	●	●			●	●	●	●	●	●	●	●		
			●	●	●	●	●	●	●	●	●	●	●	●	●		
∅AP	R/W	●	●	●	●	●	●	●	●	●	●	●	●	●	●		
	Clear To	∅BP	●	●	●	●	●	●	●			NRT	NRT	NLT	NLT		
			●	●	●	●	●	●	●	●	●	●	●	●	●	●	
		∅A or ∅B	●	●	●	●	●	●	●	●			NRT	NRT	NLT	NLT	
			●	●	●	●	●	●	●	◐	◐	●	●	●	●	●	●
∅BP	R/W	● ⤴	● ⤴	● ⤴	●	●	●	●	●	●	●	●	●	●	●		
	Clear To	∅AP	●	●	●		●	●	●	●	●	●	●	●	●		
			●	●	●	●	●	●	●	●	●	●	●	●	●		
		∅A	●	●	●		●	●	●	●	●	●	●	●	●	●	
			●	●	●	●	●	●	◐	◐	●	●	●	●	●	●	
			∅B	●	●	●	●	●	●	◐	◐	●	●	●	●	●	●

Note: The arrow indications in this illustration could not be shown correctly because of printing difficulties. Refer to page 4-23 for correct arrow format.

NRT means "No Right Turn" sign      ● means "Flashing Yellow"  
 NLT means "No Left Turn" sign      ● means "Flashing Red"

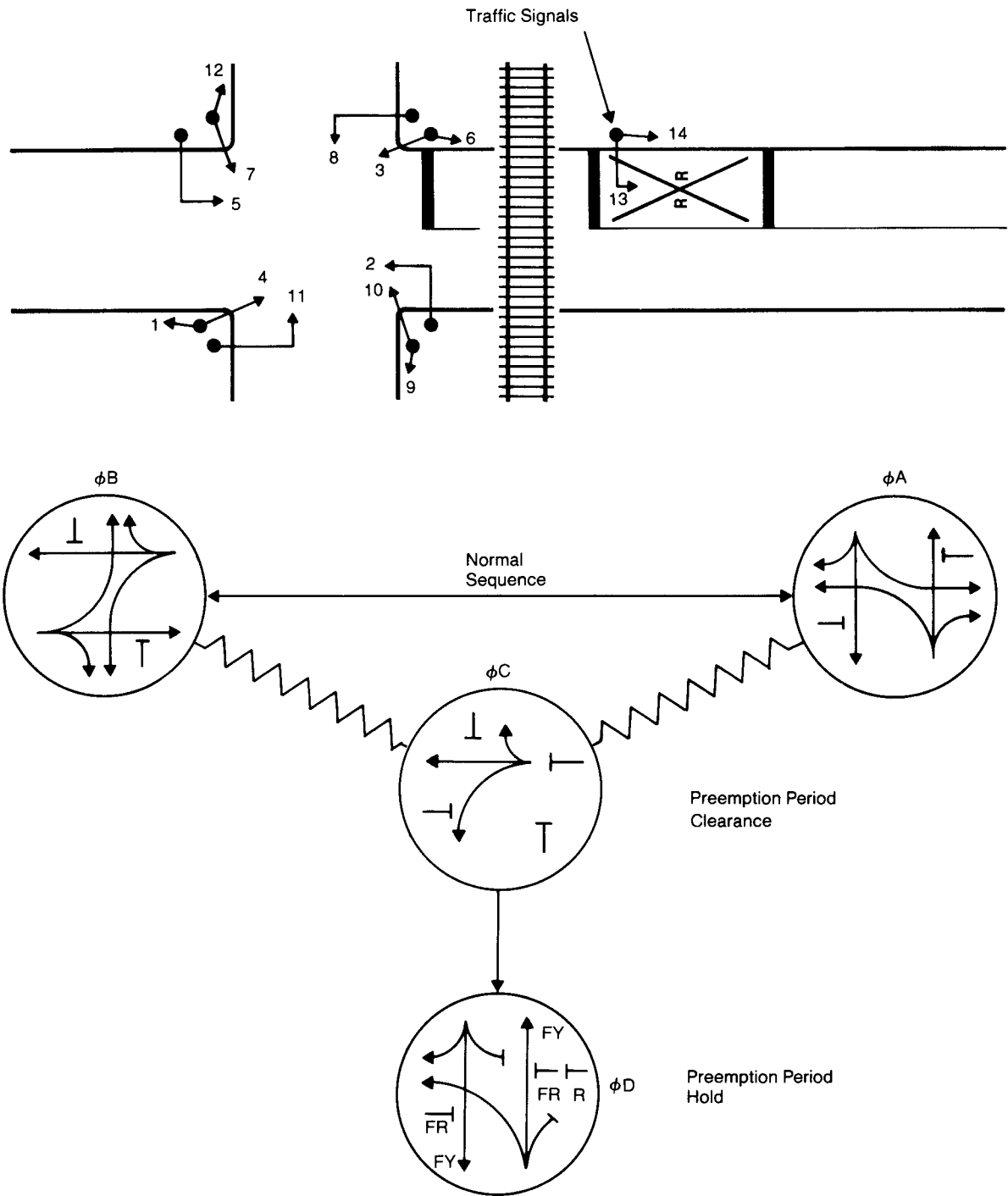
H means "Horizontal Signal Arrangement"

⊘ means "Phase" The letter following ⊘ indicates the phase

P designates a phase during the preemption period

R/W designates the signal indication in that signal face when:

The indications on the horizontal lines following "Clear To" are the signal change and clearance indications which are shown when the right-of-way is transferred by the controller to the phase indicated.



**Figure 7-8**  
**Typical preemption sequence when signal flashes during preemption hold period.**

**Table 7-2**  
**Typical Preemption Sequence When Signal Flashes During Preemption Hold Period**

Phase	Signal Ind.	1	2	3	4	5	6	13	14	7	8	9	10	11	12
ØA	R/W	●	●	●	●	●	●	◐	◐	●	●	●	●	●	●
	Clear To ØB or ØC	●	●	●	●	●	●								
		●	●	●	●	●	●	●	●	●	●	●	●	●	●
ØB	R/W	●	●	●	●	●	●	◐	◐	●	●	●	●	●	●
	Clear To ØA or ØC							◐	◐	●	●	●	●	●	●
		●	●	●	●	●	●	◐	◐	●	●	●	●	●	●
		●	●	●	●	●	●	●	●	●	●	●	●	●	●
ØC	R/W	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Clear To ØD	●	●	●				●	●	●	●	●	●	●	●
		●	●	●	●	●	●	●	●	●	●	●	●	●	●
ØD	R/W	●	●	●	●	●	●	●	●	◐	◐	◐	◐	◐	◐
	Clear To ØB	●	●	●	●	●	●	●	●						
		●	●	●	●	●	●	●	●	●	●	●	●	●	●

NRT means "No Right Turn" sign

NLT means "No Left Turn" sign

H means "Horizontal Signal Arrangement"

Ø means "Phase" The letter following Ø indicates the phase

P designates a phase during the preemption period

R/W designates the signal indication in that signal face when:



means "Flashing Yellow"



means "Flashing Red"

The indications on the horizontal lines following "Clear To" are the signal change and clearance indications which are shown when the right-of-way is transferred by the controller to the phase indicated.

## **APPENDIX**

### **Letter and Numeral Sizes**

### **Design Guidelines**

### **Sizing of Informative Sign**

**Table A**  
**Letter and Numeral Sizes for Arterial and**  
**Expressway Informative Signs**

Type of Sign	Arterials			Expressways		
	Major <sup>1</sup>	Minor <sup>1</sup>	Overhead	Major <sup>1</sup>	Minor <sup>1</sup>	Overhead
<i>A. Advance Direction and Exit Direction Signs</i>						
Exit Panel						
<sup>4</sup> Word	300	250	300	300	300	300
Numeral	350	300	350	350	350	350
Letter	350	300	350	350	350	350
Route Marker Shield	900	750	900	900	750	900
Cardinal Direction	350	200	300	350	200	300
Name of Place, Street or Highway						
<sup>3</sup> Word	450/330 <sup>2</sup>	300/200 <sup>2</sup>	400/265 <sup>2</sup>	450/330 <sup>2</sup>	350/265 <sup>2</sup>	400/265 <sup>2</sup>
Distance						
Numeral	450	300	350	450	300	350
Fraction	300	200	250	300	200	250
Word (km or m)	350/265 <sup>2</sup>	250/175 <sup>2</sup>	300/200 <sup>2</sup>	350/265 <sup>2</sup>	250/175 <sup>2</sup>	300/200 <sup>2</sup>
<sup>4</sup> Action Message Word	300	250	300	300	250	300
<i>B. Gore Signs</i>						
Word	300	250	—	400	300	—
Numeral & Letter	350	300	—	450	350	—
Type of Sign	Arterial		Expressway			
<i>C. Pull Thru Signs</i>						
<sup>3</sup> Destination Message						
Word	350/265 <sup>2</sup>		400/265 <sup>2</sup>			
Route Marker as Message						
Cardinal Direction	250		300			
Route Marker	900		900			
<i>D. Supplemental Inform. Sign</i>						
Exit Number						
<sup>4</sup> Word	250		300			
Numeral	300		350			
Letter	300		350			
<sup>3</sup> Place Name	300/200 <sup>2</sup>		350/265 <sup>2</sup>			
<sup>4</sup> Action Message Word	250		300			
<i>E. Next ( ) Exits Sign</i>						
<sup>3</sup> Place Name	300/200 <sup>2</sup>		350/265 <sup>2</sup>			
<sup>4</sup> NEXT ( ) EXITS	250		300			
<i>F. Distance Signs</i>						
<sup>3</sup> Place Name	250/175 <sup>2</sup>		350/200 <sup>2</sup>			
Numeral	250		350			

**Table A**  
**Letter and Numeral Sizes for Arterial and**  
**Expressway Informative Signs (cont.)**

Type of Sign	Arterials	Expressways
<i>G. Rest Area</i>		
<sup>4</sup> Word	250	300
Distance		
Numeral	300	350
Fraction	200	250
Word (km or m)	250	300
<sup>4</sup> Action Message		
Word	250	300
<i>H. Kilometer Posts</i>		
Word (kilometer)	100	100
Numeral	250	250
<i>I. Place Identification</i>		
<i>Signs</i>		
<sup>3</sup> Word	250/175 <sup>2</sup>	250/175 <sup>2</sup>
<i>J. Next Exit &amp; Next</i>		
<i>Services Sign</i>		
<sup>4</sup> Word	200	200
Numeral	200	200
<i>K. EXIT ONLY</i>		
<sup>4</sup> Word	300	300
<i>L. Diagrammatic Signs</i>		
Lane Width		125
Lane Lines		25x150
Lane Line Gap		150
Stem Height		1000
Arrowhead (Std. Up		
Arrow)		—
Space between		
arrowhead and		
route marker		300

<sup>1</sup> See Section 2.06 E Interchange Classification

<sup>2</sup> (/)Slash signifies the Arabic/English letter sizes

<sup>3</sup> The English translation for these names shall have initial upper case letters followed by lower case letters.

<sup>4</sup> The English translation for the words shall have all upper case letters.



## Design Guidelines

There are general guidelines to follow in the design of highway signs in order to conform to basic standards. Many of these guidelines are mentioned in various sections of this Manual while others are derived from accepted practice in sign design and layout. Most warning and regulatory signs have standardized formats. Some informative signs also have standardized formats, however, most informative signs need to be designed separately because of the variability in message or legend. For most Informative signs, there can be no rigid standardized sizes.

### Sign Dimension

Message variability controls the overall sign dimensions and, whenever practicable, the overall dimensions of the sign plates should be in multiples of 150 mm.

The use of a smaller than standard size sign may sometimes be justified. For instance, a sign mounted over a particular roadway lane to which it applies may have to be limited in width to the lane width. In some cases, vertical clearances may limit the vertical dimension of the sign. On the other hand, a larger than standard size sign may be desirable where greater legibility or emphasis is needed. When a variation in the standard size is necessary, a reduced or enlarged (as the case may be) letter height, interline, and edge spacing may be used but should be as nearly comparable to standards as possible.

### Letter Style

The Arabic type of alphabet used shall be designated by the Ministry of Communications and English as contained in the United States Department of Transportation's Standard Alphabets for Highway Signs and Pavement Markings. As a guide to choice of alphabets, tests have shown that, for any given legend, better legibility can be obtained by using relatively wide spacing between letters than by using wider and taller letters with a cramped space.

Three weights of letters and numerals are used. These are light, medium, and bold. Use of the light alphabet is restricted to Street Name signs, Parking signs, and other similar signs where limited breadth and stroke widths are required for design purposes. The bold alphabet is used for messages on arterial and expressway Informative signs. The medium alphabet is an intermediate weight that is appropriate for use on local and collector Informative signs and other signs where space is not restricted.

The English bold letters shall be a Series E (M), Metric Edition for standard alphabets

from the U. S. Department of Transportation. The English medium letters shall be Series E.

English names of places, streets, and highways on Informative signs shall be composed of lower case letters with initial upper case, for letter heights more than 200 mm.

### Size of Lettering

For Informative signs on arterials and expressways, the prescribed letter and numeral sizes, according to interchange classification and component of sign legend appear in Table A of this Appendix. Generally, for place names, the English lettering is two-thirds of the size of the Arabic lettering. The size relationship between Arabic and English is 450/330, 400/265, 350/265, 300/200, 250/175, and 200/175. For Arabic letters 175 mm and less in height, the English letters should be the same height as the Arabic.

For local and collector roads where volumes are heavy and speeds are higher, the principal Arabic legend on Informative signs shall be in letters at least 200 mm in height and in English letters at least 175 mm high. On less important local roads and urban streets where volumes are lighter and speeds are lower, the legend shall be in Arabic and English letters at least 150 mm high.

Lettering on Street Name signs should be at least 100 mm high. Supplementary lettering to indicate the type of street or section of city may be in smaller lettering but at least 50 mm high.

An accepted "rule of thumb" to follow for legibility for signs other than Expressway signs is to have 25 mm of letter height for every 15 m of desired legibility.

### Amount of Legend

The Manual states that regardless of letter size, the legend on an Informative sign must be kept to a minimum to be instantly legible. For example, on expressways, the legend on an Informative sign should only have two destinations and the directional message. Directional message, not exceeding three lines, may include symbols, route numbers, arrows, cardinal directions, interchange numbers, and other exit instructions. Collector and arterial Informative signs should be limited to six lines of principal legend (three lines in Arabic and three lines in English). Principal legend includes place names, route numbers, and street names.

All names of places, streets, and highways on Informative signs shall be in both Arabic and English.

## Arrows

Arrows for use in highway signs are shown in Section 2.04 of the Manual and illustrated below. The typical arrowhead for ground mounted Informative signs is used for all types of signs. An exception to this rule is for downward pointing arrows on overhead Informative signs which are short and broad to conserve space.

## Borders

With few exceptions, the Manual requires all signs to have a border of the same color as the legend. A dark border should be set in from the edge, while a white border should extend to the edge of the panel.

A suitable border for 750 mm signs with a light background is 15 mm in width, 15 mm from the edge. For similar signs with a white border, a width of 25 mm is appropriate. For other signs, the border widths should be of similar proportions but should not exceed the stroke width of the major lettering of the sign. For Informative signs, smaller than 2 m by 3 m, a width of approximately 30 mm may be used; for those exceeding 2 m by 3 m, the border should be about 50 mm wide; and for unusually large signs, a border 75 mm wide is appropriate.

The corners of all sign borders shall be rounded, and where practical, the corners of the sign panels should also be rounded to fit the border. On Informative signs, corner radii of the sign borders should be approximately one-eighth of the lesser side dimension except that the radii should not exceed 300 mm on any sign. The area outside the corner radius on large Informative signs need not be trimmed.

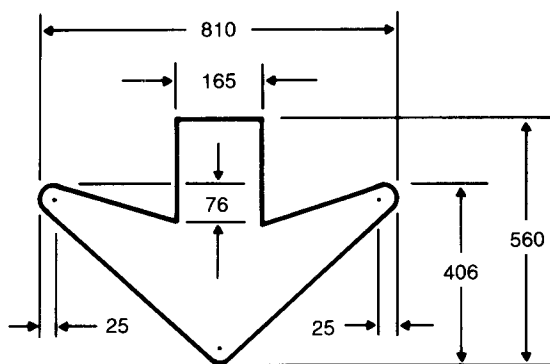
## Spacings

Interline spacing should be approximately  $\frac{3}{4}$  the average of letter heights in adjacent lines of letters.

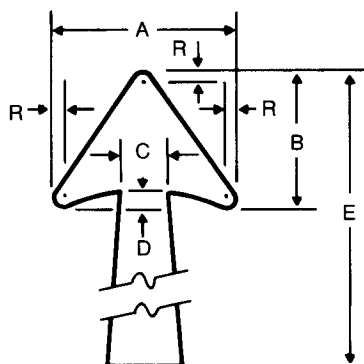
The spacings to the top and bottom borders should be approximately equal to  $\frac{1}{2}$  the average of the letter height of the adjacent line of letters. The lateral spacing to the vertical borders should be essentially the same as the height of the largest letter.

Spacing between words, words and arrow, a letter and arrow, or a word and numeral in a line of message should be approximately 1 to  $1\frac{1}{2}$  times the letter height used in that line of message.

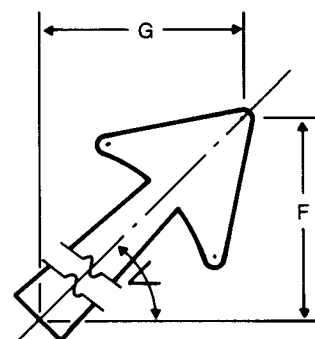
An example of sizing an Informative sign using the above guidelines is shown on the following pages.



Down Arrow



Vertical Arrow



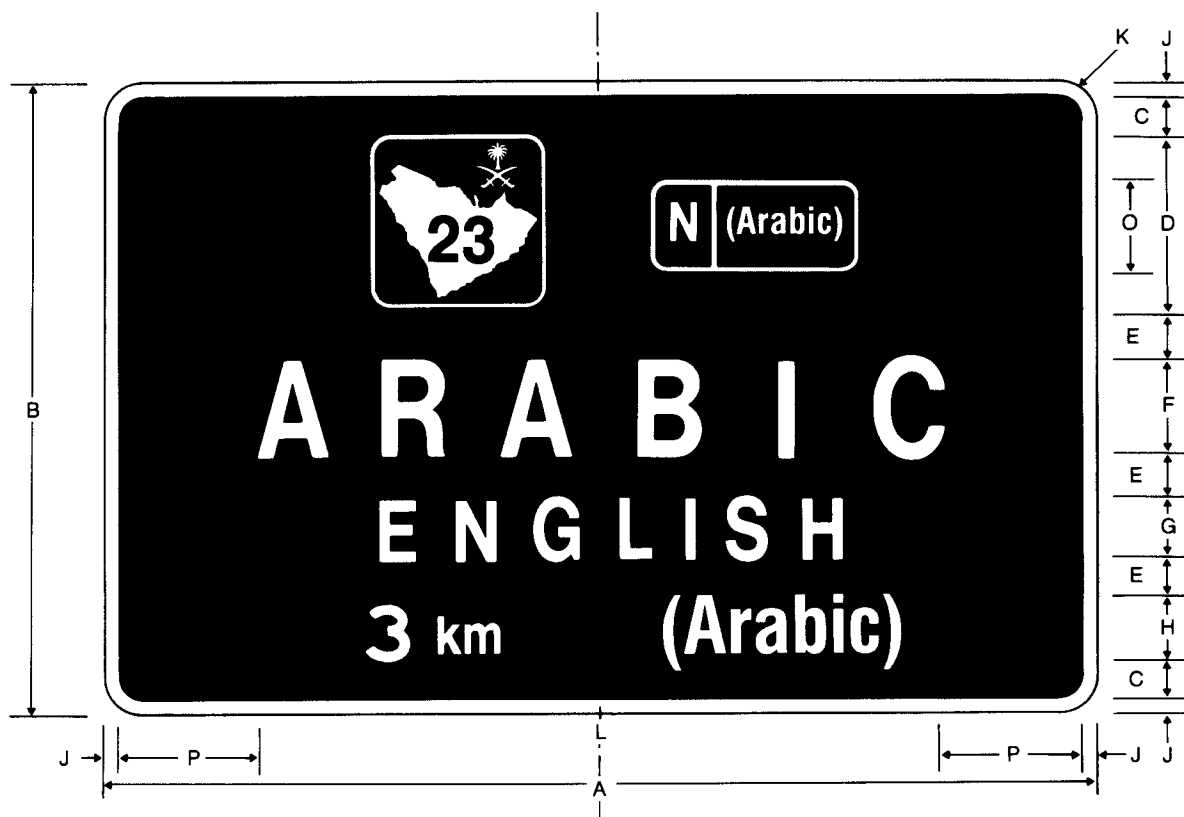
Diagonal Arrow

ARABIC LETTER SIZE (mm) (Height of Aleph)	Dimensions (mm)					
	A	B	C	D	E*	R
400-500	565	432	137	45	635-890	25
300-350	464	356	114	38	510-760	21
100-250	384	300	94	26	430-635	19

\*Taper of 10mm per 240mm should be held constant for longer or shorter shaft lengths.

ARABIC LETTER SIZE (mm) (Height of Aleph)	$\angle = 30^\circ$		$\angle = 45^\circ$		$\angle = 60^\circ$	
	F	G	F	G	F	G
400-500	445	770	630	630	770	445
250-350	270	470	380	380	470	270

### Example in the Sizing of an Overhead Advance Direction Sign



$$A = L + 2J + 2P$$

$$B = 2J + 2C + D + 3E + F + G + H$$

**J** = Border: Signs larger than 3mx2m, use 50 mm approximately. Signs smaller than 3mx2m use 30mm. Unusually large signs, use 75 mm. J should not exceed the stroke width of the major lettering.

**K** = Corner radii: Approximately  $\frac{1}{20}$  of the lesser dimension A or B. K should not exceed 300 mm.

**C** = The average of the letter height of the adjacent lines of letters;  $C = \frac{(H_1 + M)}{2}$

**D** = Depth of route marker

**E** = Interline spacing: Approximately  $\frac{3}{4}$  the average letter heights in adjacent lines;  
 $E = \frac{3}{4} \frac{(F + G)}{2}$

**F** = Height of Arabic letter (refer to Table A, Appendix)

**G** = Height of English letter (refer to Table A, Appendix)

**H, M & N** = Height of distance (refer to Table A, Appendix)

**O** = Height of cardinal direction (refer to Table A, Appendix)

**P** = The lateral spacing to the vertical borders should be essentially the same as the height of the largest letter

**L** = Length of longest destination

1. Calculate total width A

$$A = L + 2J + 2P$$

$$A = L + 2(50) + 2 \frac{(400 + 265)}{2} =$$

$$L + 100 + 660 = L + 760 \text{ mm}$$

2. Calculate vertical depth

$$B = 2J + 2C + D + 3E + F + G + H$$

$$B = 2(50) + 2 \times \frac{1}{2} \frac{(375 + 300)}{2} + 900$$

$$+ 3 \times \frac{3}{4} \frac{(400 + 265)}{2} + 400 + 265 + 375$$

$$B = 100 + 338 + 900 + 748 + 400 + 265 + 375 = 3126 \text{ mm}$$



## General Glossary

### - A -

**Approach**—All lanes by which vehicles may lawfully proceed toward an intersection.

**Arterial Highway or Street**—A highway primarily for the movement of through traffic. It may have either grade intersections with other highways or grade-separated intersections. A design classification used to define these types of roads.

### - B -

**Beacon**—A type of traffic control signal, generally used with an appropriate sign, in which the red or yellow lens or lenses are alternately illuminated and darkened at a rate of about once per second.

**Breakaway (Yielding) Supports**—A support for a roadside device which yields or collapses readily when struck by a vehicle.

### - C -

**Change Interval**—A division of the time cycle during which a yellow signal indication is given to warn approaching traffic that must stop.

**Clearance Interval**—A division of the time cycle during which the signal indications prohibit conflicting traffic from entering an intersection while a traffic movement which has lost the right-of-way is passing through the intersection.

**Collector Highway or Street**—A highway which provides a combination of land access and movement of through traffic. A design classification for these type roads.

### - D -

**Detector**—A device by which vehicles and pedestrians are enabled to register their presence or passage.

### - E -

**Eighty-Fifth Percentile Speed**—The speed at or below which eighty-five (85) percent of the vehicles are being operated.

**Expressway**—A multi-lane, divided highway designed to move large volumes of traffic at high speeds under free-flow conditions. Expressways have full control of access with grade-separated interchanges.

### - F -

**Fail-Safe**—The feature of a device, upon failure of its normal operation, which causes it to return to or remain in a condition that does not result in unsafe conditions for the functions which it controls.

### - G -

**Gap**—The length of time between successive vehicles in the same direction as they pass a point on a highway or street. It is measured from the rear of the leading vehicle to the front of the following vehicle.

### - H -

**Housing**—That part of a signal head to which the optical unit and door are attached for support and protection and attachment to other parts of the signal assembly.

### - I -

**Indication**—The illumination of a traffic signal lens.

**Interval**—Any one of the several divisions of the time cycle during which the signal indications do not change.

### - L -

**Lagging**—As applied to a signal indication and the accompanying traffic movement, means that they follow the principal movement. They may occur following the stopping of the movement from the opposite approach, or after the through movements of both approaches have been stopped.

**Lane**—A portion of the traveled way providing for a single line of traffic in one direction.

**Leading**—As applied to a signal indication and the accompanying traffic movement, means that they occur before the principal traffic movement on that approach. Most frequently, it is applied to a left turn indication which precedes the display of the Green indication for traffic from the opposite approach.

**Level Crossing**—The crossing of a roadway and the tracks of a railroad at the same grade.

**Local Street or Local Road**—A street or road primarily for access to residence, business, or other abutting property. A design classification for these type roads.

### - M -

**Major Street**—The roadway approach or approaches to an intersection which normally carry the greatest volume of vehicular traffic.

**Minor Street (Cross Street)**—The roadway approach or approaches to an intersection which normally carry less vehicular traffic than the major street.

### - P -

**Pavement Markings**—Devices placed on the

roadway to mark pavement for vehicular and pedestrian traffic control.

**Pedestrian**—A person on foot.

**Pedestrian Crossing (Crosswalk)**—An area reserved and clearly marked for the passage of pedestrians at street junctions or other locations where drivers must yield the right-of-way by stopping to enable pedestrians to cross safely.

**Permissive Movement**—A traffic movement which is allowed by a permissive signal indication to take place, even though conflicting movements may be allowed at the same time.

**Phase**—A part of a signal cycle during which a specific traffic movement (and concurrent nonconflicting movements) receives the right-of-way. It includes the change and clearance intervals associated with those movements.

**Portable Traffic Control Signal**—A signal that is designed to be moved as a unit to the site and be operated for a limited time. (It normally consists of the necessary signal faces on poles attached to moveable bases, a control unit, the necessary electrical cables, and a power supply.)

**Post-Mounted Signal**—A signal head which is set on the top of its supporting post or is attached to the side of the post or pole.

**Pretimed Signal**—A type of traffic control signal in which the cycle, phasing, intervals, and indications are predetermined and do not vary. They are repeated until changed manually or by a control mechanism such as a clock or master controller.

**Progressive Signal System**—A traffic signal system in which the successive signal faces controlling traffic along a street give "GO" indications in accordance with a prearranged time schedule. This schedule is designed to allow (as nearly as possible) the continuous operations of groups of vehicles along the street at a planned rate of speed.

**Protected Movement**—A traffic movement during which there is no traffic movement which conflicts with the protected movement.

- S -

**Sequence**—The order in which the signal indications or phases appear.

**Signal Face**—That part of a signal head which contains the indications for controlling a single traffic movement.

**Signal Head**—An assembly of one or more signal faces, housings, hardware, and accessories. It may be termed "one-way," "two-way," etc., dependent on the number of faces and the direction(s) in which they are aimed.

**Signal System**—A system of visual signals used to control the movement of traffic, usually on city streets.

**Split**—The division of the cycle length which is allocated to each of the phases (normally expressed in percent).

**Stop Line**—A white line, placed transversely on the pavement, at an intersection, to indicate where the vehicle must stop when obeying a traffic signal or stop sign.

**Street or Highway**—A public way that is open to the movement of vehicular traffic, pedestrians, and transportation by other means or conveyances. The entire width between the right-of-way lines of any way open to public traffic.

- T -

**Traffic-Actuated Signal**—A type of traffic control signal in which the length of most intervals and the cycle, and in some types the sequence of phasing, are varied by the demands of traffic.

**Traffic Control Devices**—Signs, signals, markings, and devices placed or erected by proper authority having jurisdiction, for the purpose of regulating, warning, or guiding traffic.

**Traffic Control Signal**—An electrically operated device by which traffic is alternately directed to stop and permitted to proceed by the display of red, yellow, and green light indications.

**Traffic Markings**—A traffic control device consisting of lines, patterns, words, symbols, or colors on the pavement, or adjacent to the roadway.

**Traffic Sign**—A traffic control device mounted on a support above the level of the roadway that conveys a specific message by means of words or symbols.